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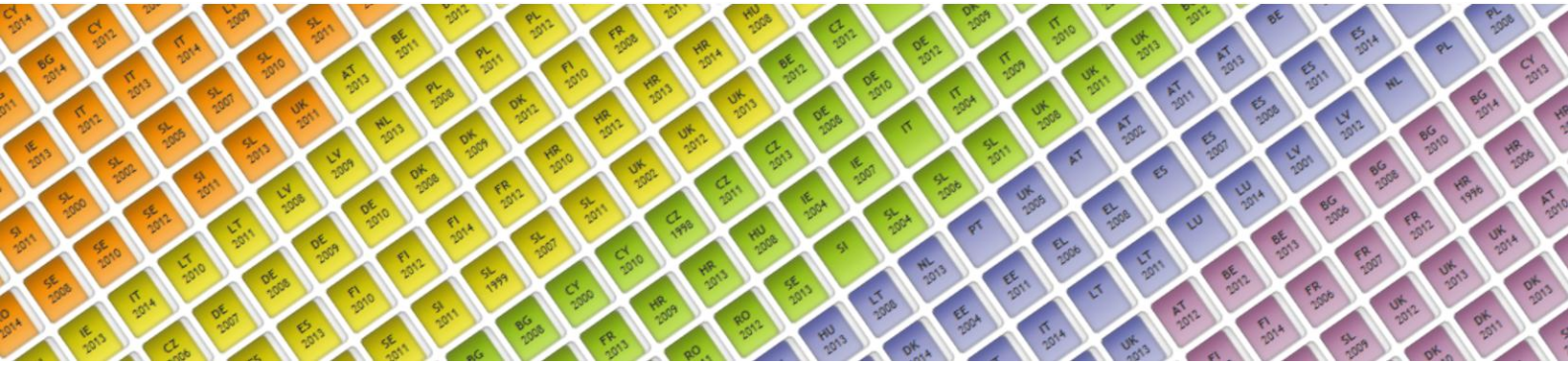

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Abstract

The report offers an analysis of the R&I system in Sweden for 2014, including relevant policies and funding, with particular focus on topics critical for two EU policies: the European Research Area and the Innovation Union. The report was prepared according to a set of guidelines for collecting and analysing a range of materials, including policy documents, statistics, evaluation reports, websites etc. The report identifies the structural challenges of the Swedish research and innovation system and assesses the match between the national priorities and those challenges, highlighting the latest policy developments, their dynamics and impact in the overall national context.

Acknowledgments

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Executive summary

This is the latest in a series of annual reports which seek to provide a snapshot of developments in Swedish R&I policy landscape and monitor progress in two policy areas that are coordinated at the EU level: the European Research Area and the Innovation Union. The report is prepared on the basis of a set of guidelines for collecting and analysing a range of materials, including policy documents, statistics, evaluation reports, websites, etc. The quantitative and qualitative data is, whenever possible, comparable across all EU Member State reports. The report will cover the following aspects:

- An overview of the national research and innovation context;
- Progress towards addressing identified research and innovation system challenges;
- National activities contributing to towards achievement of the European Research Area;
- National activities supporting progress towards the Innovation Union;
- Progress in addressing Europe 2020 country specific recommendations related to R&D and innovation.

Sweden accounts for 1.9% (9.74m) of the EU28 total population. Sweden's GDP per capita (2013, ESA 2010 adjusted) is almost 1.6 times that of the EU-28 average, i.e. €42,900 (EU-28 average €27,000). In 2013, gross domestic expenditure on research and development (GERD) amounted to 3.21% of GDP (ESA 2010 adjusted), compared to an estimated average of 2.02 % for EU-28. The Swedish R&I system is characterised by high diversity in its funding arrangements and low diversity in the performing organisations. Firms account for at least two thirds of the research funded and corporate R&D sector is clustered mainly around five sectors: metals, computers, etc.; transport and automotive supplies; furniture and other manufactured goods and pharmaceuticals. Throughout 2013 Sweden maintained its four year top rank as an innovative nation, being second only to Switzerland on the Global Innovation Index. However, increasing globalization of the small number of large firms on which Sweden's economy depends has meant an increasing policy focus on diversification.

The public sector research effort is divided among three main types of research performers, universities and university colleges, research institutes and last but not least public authorities that perform in house research. 36 universities and university colleges perform two thirds of the publicly financed research in Sweden. This includes basic, applied and strategic research; the sector also performs tasks such as government investigations, surveys, etc. Higher education institutions in Sweden therefore have a unique opportunity in that research of all types is co-located in the same setting. The Swedish HEI sector is quite strong but in recent years there have been concerns about declining performance. At present Sweden is slightly below the EU average in terms of production of publications that attract international citations. The balance of project to institutional funding in Sweden is 60/40 and this has been so for more than a decade. The country report for Sweden stresses the need to address the poor performance of the Swedish primary and secondary school systems. Sweden is currently struggling to address this issue.

A perusal of Swedish research policy would reveal that many of the ERA initiatives have been implemented and are institutionalized in the public research system. There has always been a system of transparent recruitment and grants are accessible and portable, although more could be done to spread knowledge to the research community about grant portability. There is a great deal of emphasis on mobility and recently there have been attempts to address repatriation difficulties by providing support. The career prospects for younger researchers after the short term postdoctoral positions are however still unclear. The introduction of student fees for non EU students has led to a marked reduction in the numbers of non EU students. There is however an increase in the numbers of EU students at the undergraduate and masters'.

The Swedish Research Council presented its reports on Open Access, research infrastructure and research evaluation to the government in early 2015. The Open Access proposal is scheduled to be implemented in 2017 granted it has been accepted by the government. All public research funders have an open access publications policy for grantees. The policy from 2017 will extend the current requirements. The council has recently completed a proposal and public consultations on how to fund and secure research infrastructure. This report is now being followed up with an inventory of the national research infrastructure and in 2016, it is expected that a budget for research infrastructure will be proposed in 2016. Last but not least, the 2012 Research and Innovation Bill suggested the introduction of a regular national evaluation exercise and the Swedish Research Council and VINNOVA were charged with devising a solution. A proposal is now being considered by government.

Swedish efforts to diversify economic dependence on a few large multinationals have issued into a focus on supporting high tech firms, improving digital and physical infrastructure and the framework conditions for small and medium sized companies (SMEs). The most important structural challenges for the Swedish R&I system are addressing the imbalance between private and public venture capital. Related to this is the problem of the availability of early stage risk capital for fledgling firms. 99% of Swedish SMEs are of the <50 employee category and available evidence suggests that these firms remain in this category for several reasons. Two of the most important of which are the costs of hiring labour, which is ironically very expensive not because of wages per se but because of taxes associated with hiring personnel. The government has been trying to address the above issues and a number of measures have been introduced to take care of this problem. There is however an urgent need to address the proliferation of public venture capital and the general low level of efficiency of these initiatives.

Although traditionally slow to introduce fiscal reform of the kind that would lead to reduced taxes for high income earners, Sweden has recently taken a number of small steps in the direction of fiscal reform. In January 2014, the conservative coalition government introduced a tax incentive for business investment in R&D. This was reinforced by an attempt to provide liquidity for the fledging private risk capital market through the creation of a tax deduction for investment in non-stock indexed firms that are under 50 employees. The third financial instrument of note is the investment savings account which is in effect a reduction of capitals tax for investors. This is open to private individuals but as yet, there has been little interest.

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1. Overview of the R&I system

The Swedish population accounts for 1.9% of the EU28 total population. In absolute figures, this is 9,737,521 (SCB, accessed October 31, 2014), a change of approximately +1.01% from the figures reported in last year's country report. This increase may be attributed to an influx of migrants as a result of instability in Syria as well as an increase in births. This implies that the demographic trend of an aging population remains largely unchanged. GDP per capita (2013, ESA 2010 adjusted) [1] is almost 1.6 times that of the EU-28 average, i.e. €42,900 (EU-28 average €27,000). The GDP growth rate in 2013 was 1.6% compared to 0.9% in 2012, 2.9% in 2011[2], and 6.6% in 2010 (see table 2). Sweden has long since been one of the countries in the world with the highest annual R&D investment in percentage of GDP (only surpassed by Finland, Israel, and South Korea in 2011) and is consequently the EU country with the second highest total annual R&D expenditure relative to GDP, after Finland[3]. In 2013, gross domestic expenditure on research and development (GERD) amounted to 3.21% of GDP (ESA 2010 adjusted), compared to an estimated average of 2.02 % for EU-28.

1.1 Sweden in the European RDI landscape

Sweden has historically been among those countries which invest a large share of GDP in R&D annually and in 2012, domestic R&D expenditure amounted to 3.41% of GDP, compared to an estimated average of 2.05% for EU-28. The long-term trend for Sweden shows a decline in R&D intensity, with the figure on total R&D investments as a share of GDP dropping from 4.18% in 2001 to 3.41% in 2012 and to 3.21% in 2013. This development is opposite to most EU countries, where corresponding figures have increased over the same period. The explanation for the decline lies predominantly in the private sector, as Business Expenditures for Research and Development (BERD) relative to GDP have shrunk from 2.55% in 2009 to 2.36% in 2013. Public investment in R&D has fluctuated somewhat in recent years, but remained steady on long term, amounting to approximately 0.8% of GDP in 2012. The turnover from innovation, defined as the share of total turnover of an enterprise and market that comes from products and services that are new to the enterprise and new to the market, has fluctuated between 8.4% and 15% in 2006-2010 (EU-28 average in the same period was around 13.5%; newer data is unfortunately not available).

[1] http://appsso.eurostat.ec.europa.eu/nui/submitViewTableAction.do; If not referenced otherwise, all quantitative indicators are based on EUROSTAT data.

[2] The shift to ESA has had a noticeable effect on the statistical data and the largest observed difference thus far is in 2011 where a difference of as much as 5.1% is registered. According to Statistics Sweden, 4.1% of this increase may be attributed to the change in the accounting system (Statistics Sweden 2014a). Two aspects of this new accounting system are important to note for the purposes of this report. The first is that R&D expenditure is now counted as an investment rather than a cost in production and capital investments, the other is that investments in, for example, a new weapon system for defence should be classified as fixed capital. The effect of these changes is that for the period 2000-2013, Sweden's GDP showed an average increase of 2.2% (SCB, National Accounts 1993-2012). GDP for 2013 increased by 1.5% compared to 2012, GDP per capita (2013) is €42,764, almost twenty times that of the EU-28 average.

[3] Original source: OECD 2012 - http://www.ekonomifakta.se/sv/Fakta/Utbildning-och-forskning/Forskning-och-utveckling/Forskning-och-utveckling-internationellt-/

Perusal of business expenditure on R&D by sector would reveal that the top five sectors in terms of R&D expenditure are: metals, computers, etc.; transport and automotive supplies; furniture and other manufactured goods and pharmaceuticals. Transport and automotive supplies is also an area in which there is high public R&D investment. Throughout 2013 Sweden maintained its four year top rank as an innovative nation, being second only to Switzerland on the Global Innovation Index. However, in 2014 United Kingdom overtook this position and Sweden slipped down to a third position. The main reason behind the fall is the drop in innovation inputs.[4]

1.2 Main features of the R&I system

The Swedish R&I system is characterised by high diversity in its funding arrangements and low diversity in terms of the categories of research performing organisations in the system. Firms account for at least two thirds of the research funded. The public sector research effort is divided among three main types of research performers: universities and university colleges, research institutes and last but not least public authorities that perform in house research. The university and university college system is the largest part of the public research performing sector. Almost two thirds of publicly financed research in Sweden is done at 36 universities and university colleges.[5] Industrial research institutes are not part of the higher education sector but are classified as knowledge intensive firms and are organised under one umbrella organisation (RISE) which is a publicly owned company. There are a number of small public research institutes that are special purpose organisations such as the Swedish Institute of Advanced Studies but these are not of direct relevance to RI policy. Large scale research infrastructure in Sweden is incorporated in universities so there is no national lab system. University hospitals are excluded from the category "research infrastructure". These units are financed through a shared financing system between the universities and the municipality in which the university is located. There is a special research fund for clinical research and this is administered at the county council level.

There is a separate source of funding for purchasing and maintaining research infrastructure but since 2009 this type of funding is intended to fund only research infrastructure that is national in character. A new system for funding and prioritising research infrastructure is now in place.[6] Research infrastructure that is specific to a particular research group or a university but is not developed for national purposes has to be maintained from funding raised by the research group that uses the infrastructure. This would suggest that the proportions of institutional to project funding may vary not only

[4] The Innovation Input Sub-Index: Five input pillars capture elements of the national economy that enable innovative activities: (1) Institutions, (2) Human capital and research, (3) Infrastructure, (4) Market sophistication, and (5) Business sophistication. Source: Global Innovation Index 2014, p. 7 and Tillväxtanalys, (2014) Innovationsklimatet I Sverige 2014. Indikatorer till den nationella innovationsstrategin

[5] University colleges differ from universities in that they were originally not intended to do doctoral education. Since 2000 this distinction was removed and some university colleges were granted the right to do doctoral education in some subjects. In 2010, the government discontinued this practice but university colleges may still apply to educate doctoral students in a particular subject. Generally, university colleges have lower research intensity than universities. www.uka.se

[6] http://www.vr.se/forskningsinfrastruktur/vetenskapsradetsguidetillinfrastrukturen.4.61663a161121008575380002821.html The first calls for this are now open but no budgetary information will be available before 2016.

among types of research performers (universities versus research institutes) but also between performers in the same category depending on the amount of research infrastructure they manage.[7]

1.3 Structure of the national research and innovation system and its governance

The national R&I system is governed through the Research Bill[8] which is produced every four years. In addition, there is at present a National Innovation Strategy which is intended to provide guidelines for innovation policy up to 2020.[9] The Research Bill suggests the budget and agenda for research for the four years after it. Both of these documents are created in a process of consultation with the main stakeholders in the sector. They also represent two instances of more centrally driven priority setting for the national RI system. Generally, the system is governed in a bottom up fashion that has given rise to charges of fragmentation because of the degree of stakeholder influence. An illustration of this is the Strategic Innovation Areas at VINNOVA which is a meta programme, i.e. a programme which includes several sub programmes. The general thrust of the programme is collaborative. It is a joint venture among three funders: VINNOVA, FORMAS and the Swedish Energy Agency. These actors were charged with responsibility for this programme in the 2012 Research Bill. The Strategic Innovation Areas meta programme includes two sub programmes: Strategic Research and Innovation Agendas and Strategic Innovation Programmes. Strategic Research and Innovation Agendas are based on a bottom up priority setting process in which stakeholders from the research performing sector, SMEs, large firms and other public authorities are invited to suggest specific research and innovation programmes.[10] This invitation is done via a research call and the budget devoted to this activity was €1m and it was expected that 15-20 strategic innovation areas would be funded. The call was made in 2012 and since then it has been repeated regularly, there are now about 136 strategic innovation agendas.[11] The strategic innovation programmes represent the instruments for implementing the strategic research and innovation agendas. Currently there are 15 strategic innovation programmes.[12] There will be no new calls in this area in 2015.

The funding outlined in the budget accompanying the Research Bill does not represent the entire research budget. There is a significant sectoral budget which is allocated to and distributed by government agencies such as the Transport and Energy Agencies.[13] This

[7] Given that research groups are often responsible for maintaining infrastructure, there may be local solutions to how both institutional and project funding is used to support infrastructure of this type. This would need to be taken into account when one compares the amount of funding available to universities vis a vis each other and similarly for research institutes.

[8] http://www.regeringen.se/sb/d/15650/a/201368

[9] http://www.vinnova.se/upload/EPiStorePDF/DenNationellaInnovationsstrategin.pdf

[10] http://www.vinnova.se/EffektaXML/ImporteradeUtlysningar/2012-01394/Agendabidrag%20f%C3%B6r%20Strategiska%20FoI-agendor_2805%28393904%29.pdf

[11] http://www.vinnova.se/PageFiles/750895771/agendakatalog-150219a-webb.pdf

[12] http://www.vinnova.se/sv/Var-verksamhet/Gransoverskridande-samverkan/Samverkansprogram/Strategiska-innovationsomraden/Strategiska-innovationsprogram/

[13] In the case of the Energy Agency, there is a special Energy Research Bill that is produced every four years, see

money would be accounted for statistically in the category GBAORD. Both of these agencies perform in-house research and fund a significant amount of energy research. SIDA, the Swedish Development Agency has a research funding function which has an annual budget of circa €100m. The Swedish Energy Agency has a total research budget of €130m (2014)[14] and the total budget for research and innovation in transport and telecommunications is approx. €180m[15]. These sectoral budgets when compared with the basic science research budget would suggest that the funding system is skewed towards needs driven research. This is however a difficult judgement to make even if one refrains from trying to answer the bigger question of what should be the balance. An important contributing factor here is that even actors like the Swedish Energy Agency often fund basic research and the other research councils do have thematic calls with emphasis on user interaction, etc. Since universities are the largest research performers outside of the corporate sector, all these types of research take place in the same context and this is a key enabling factor for knowledge transfer.

Given the dominance by the university sector of the research performers' landscape, the Research Bill is the governance instrument that weighs heaviest in terms of agenda setting. Governance may be broken down into two sub categories, which agency or actor decides over which aspect of the research system and the rules and procedures for deciding what counts as performance. Table 1 located at the end of this section provides a breakdown of the sources of research funding in Sweden and the distribution of authority rights across funders. This is not an exhaustive analysis as it only includes the largest research funders and does not include public agencies which are direct funders of research and even provide loans and venture capital to start ups and SMEs such as the Swedish Energy Agency.

Authority rights describe the way in which power is distributed in the research funding system and the way in which the system exercises governance over research through specific categorisations. These categorisations are in their turn based on both local and international considerations. For instance, in Sweden, national knowledge traditions dictate that a special research council exists for funding research on working life. Table 1 shows that the Swedish system is one in which the authority rights are distributed among several different actors. The Ministry of Education has direct authority over the entire higher education and research sector. However, the Ministry's power is attenuated by a public service structure which delegates power from the Ministry to specialized agencies (e.g. the Swedish Research Council). These agencies also advise the Ministry through a system of annual reporting.

An additional complicating factor with respect to authority rights for research funding is that they do not all inhere in the Ministry of Education and the agencies which it manages. Sectors such as transport, defense and energy have substantial R&D budgets and the agencies which manage these budgets are in turn managed by the Ministries of Transport, Defense and Energy respectively. Research on aid and development is also organized as sector research and is administered by the Swedish Development Agency (Sida) which is in

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http://www.regeringen.se/download/6a6bdeb8.pdf?major=1&minor=201962&cn=attachmentPublDuplicator_0_attachment

[14] Source of figures is the Swedish Energy Agency and figures are for 2014 http://www.energimyndigheten.se/Forskning/ accessed 2015-03-12

[15] These figures are taken from statistics Sweden and are for 2013 http://www.scb.se/sv_/Hitta-statistik/Statistik-efter-amne/Utbildning-och-forskning/Forskning/Forskning-och-utveckling-i-offentlig-sektor/244514/244522/301715/# accessed 2015-03-12

its turn managed by the Ministry for Foreign Affairs. In addition to these actors, there are two research councils devoted to sector interests: they are the Swedish Research Council for Health, Working Life and Welfare and the Swedish Research Council for Environment, Agricultural Sciences and Spatial Planning.

The Swedish research funding system has another category of public funders in addition to those that are directly managed by the government through annual budget locations; these are the public foundations such as the Foundation for Strategic Environmental Research and the Foundation for Strategic research (medicine, engineering and natural science). These actors fund large scale research programmes from budgets that are financed by interest from a public endowment. Last but not least, there are the private foundations, such as the Wallenberg foundation, that are important funders.

Main changes in 2014
…Introduction of a new model for prioritisation and funding of research infrastructure
…Finalisation of funding for ESS
…Completion of proposed models for national evaluation of research and research impact
Main Changes in 2013
… Decision to introduce funding initiatives to strengthen research in the humanities and social sciences
…Decision to increase the share of institutional funding which is performance based
Main changes in 2012
…Publication of new Research Bill outlining priorities until 2016and the National Innovation Strategy outlining priorities until 2020
…Introduction of a fast track recruitment procedure for recruitment of professors from outside of Sweden
…Introduction of call for identification of strategic innovation areas
Main changes in 2011
…Decision to initiate a programme for innovation in the construction industry
…Pilot project on support for the development of science parks (VINNOVA, responsible funder)
… Introduction of autonomy reform for universities and university colleges
Main Changes in 2010
…Initiation of the programme Europe and Global Challenges (cross border collaboration in funding between Sweden, Germany and Italy)
…Initiation of a program for funding research on civil society
…Start of the strategic research areas

Table 1. List of most important public research funders, area of responsibility and Coordinating Agencies

Research funders	Area of Funding	Ministry responsible
Swedish Energy Agency www.energimyndigheten.se	Funds research on creating the prerequisites for an ecologically and economically sustainable energy system Main tasks in research funding are: funding, business development, network building, statistics, evaluation and governance of energy R&D	Ministry of Enterprise, Ministry of Energy and Environment
Swedish Research Council for Health, Working life and Welfare www.forte.se	Basic and applied research on health and health care, working life and work organization, welfare including social policy and social work. Main tasks: research funding, research communication and evaluation	Ministry of Health and Social Affairs
Swedish Research Council, Formas www.formas.se	Basic and applied research to promote sustainable development Main tasks: research funding and communication of research results	Ministry of Environment and Energy
Swedish Environmental Protection Agency www.naturvardsverket.se	Funds interdisciplinary research on the environment and nature protection Main tasks: funding, statistics, evaluation and control of R&D on environmental protection	Ministry of Environment and Energy
Swedish national space board www.rymdstyrelsen.se	Research, development and other work connected to Swedish space and remote sensing Main tasks: Research funding	Ministry of Education and Research
Swedish International Development Cooperation Agency www.sida.se	International research support for development work and support to Swedish R&D on development cooperation Main tasks: Research funding and development cooperation	Ministry of Foreign Affairs
Swedish Radiation Safety Authority http://www.stralsakerhetsmyndigheten.se/	Research on radiation protection and nuclear safety Main tasks: funding, statistics, evaluation and governance of R&D on radiation protection	Ministry of Environment and Energy
Swedish Research Council www.vr.se	Develop and fund basic research of the highest quality in all scientific areas Main tasks: funding, statistics and analysis, evaluation and research policy, research communication	Ministry of Education and Research
Swedish Innovation Agency (VINNOVA) www.vinnova.se	Development of Sweden's innovation system in order to promote sustainable economic growth Main tasks: Research and innovation funding and network building	Ministry of Enterprise

Table 2. List of most important public research foundation, area of responsibility and annual budget

Public Foundation	**Area of Funding**	**Annual budget for research (approx.)**
Swedish Foundation for the Humanities and Social Sciences www.rj.se	Humanities, Social Sciences Main tasks: Research funding and network building	€0.4m
Knowledge Foundation www.kks.se	Knowledge and competence exchange between universities, research institutes, firms and university colleges Information technology Research at university colleges	€20m
MISTRA, Foundation for strategic environmental research www.mistra.org	Research on a good living environment and sustainable development Main tasks: Research funding and network building	€20m
Foundation for Strategic Research www.sfs.se	Funds natural science, technical and medical research Main tasks: Research funding	€50,8m
Swedish Foundation for International Cooperation in Research and Higher education (STINT) www.stint.se	Funds mobility of researchers & teachers to promote internationalization of higher education Main tasks: Research funding	€6,5m

2. Recent Developments in Research and Innovation Policy and systems

2.1 National economic and political context

The impact of the global financial crisis was fairly low in Sweden but the first signs of slowing of growth began to emerge in 2011. In 2011, business expenditure on R&D decreased slightly as there was a reduction in spending, a trend which held true for 2012 as well. Statistics Sweden reported no change in this trend for 2013. According to the National Institute of Economic Research, growth in the Swedish economy over 2013 and 2014 has been sluggish mainly as a result of weak demand from the euro area (NIER, 2014). Growth in exports is expected to rise from 2.4% in 2014 to about 5% in 2016 and 2017 (NIER, 2014). Inflation is well below 2% and the Central Bank of Sweden has reduced the repo rate to below 0%. The new minority government has promised a reduction in the interest rate on student loans. The majority of business R&D is performed in firms with 200 or more employees. The increasing globalisation of the ownership of these firms over the last ten years or so has contributed to the decline in business investment in R&D shown in Sweden. The reason for this is that these firms are now sourcing R&D globally. This change in sourcing pattern has implications for the public research sector in Sweden as well. The most significant of which is that Swedish R&D personnel have to be globally competitive in order to be able to continue to keep their position as knowledge providers.

There was a general decrease in the availability of risk capital for the early and growth phases and according to the Swedish Association for Risk Capital (SVCA), the level of investment reduced by about 60% in the period 2008 -2012. The figures for 2012 showed an investment volume of circa €197m. The bulk of investment went to computer and consumer electronics (35%) and the life sciences (31%). According to statistics made available in November 2014 by the Swedish Agency for Growth Analysis, this negative trend broke in 2013 and total investments were amounting to about €210m.[16] This break was also accompanied by a change in the pattern of investment. According to the Swedish Agency for Growth Analysis, the firms in the the construction industry attracted the majority of the available investment capital between 2005 and 2012. The Agency reported a 7% increase in the number of newly started companies in the second quarter of 2014 (17,698) compared to the same period in 2013 (16,597).[17] This also signalled yet another change, a shift in the pattern of investment away from construction and towards life sciences and information technology. Investments in Life Science mainly consisted of reinvestments, while the majority of investment in the IT industry went to companies not previously venture-backed.[18]

Sweden got a new government in 2014 and it is expected that the shift in regime will be significant for economic policy. The budget[19] was announced on 23rd October, 2014 and the

[16] http://www.tillvaxtanalys.se/en/home/publications/statistics/statistics/2014-11-28-venture-capital-statistics-2013---investments-in-swedish-portfolio-companies.html

[17] http://www.tillvaxtanalys.se/sv/statistik.html.

[18] http://www.tillvaxtanalys.se/en/home/publications/statistics/statistics/2014-11-28-venture-capital-statistics-2013---investments-in-swedish-portfolio-companies.html

[19] The new Swedish government has not been able to get its budget accepted in Parliament and the government together with the conservative coalition have made a compromise agreement which allows for the deadlock over the budget to be overcome. This arrangement allows for those budgetary issues on which the conservative coalition and the minority government can reach agreement to be accepted for 2015. A

signal that may be read from this document is that the focus for this mandate period will be on traditional welfare concerns such as health and schools. The government has signalled a particular interest in reduction of unemployment which is at the present time 7.4% (www.scb.se accessed January, 2015) as compared to the EU 28 average which is approximately 10%. A general increase in government spending and taxation appear to be features that will dominate the economic and political landscape for the next three years. Read from the perspective of innovation policy, this may have a negative effect on the availability of private risk capital. The combination of increased income tax taken together with a fiscal policy aimed at increasing the public budget at the expense of individual savings and disposable income is generally regarded as likely to produce a deflationary effect on private investment. This impact may be offset by increased availability of public venture capital through government agencies such as ALMI, which received a larger budget from 2015 (€14m). This increase is controversial given the results from the evaluation of ALMI's counselling of companies done by Tillväxtanalys (2014) and discussed later in this report. Additionally, there has been a longstanding complaint particularly from interest organisations such as Swedish Industry (SN, 2014) that public venture capital is inefficient. There is some evidence that these concerns may be addressed in the future as the new Innovation Council to be led by the Swedish Prime Minister has this issue on its agenda. A key issue in this regard is the more deep seated problem of low personal savings which decreases overall availability of private risk capital.

2.2 National R&I strategies and policies

The National Innovation Strategy and the Research Bill produced in 2012 remain the point of departure for research and innovation strategies and policies. Although Innovation Strategies are fairly new, both the Research Bill and the Innovation Strategy are done in broad consultation with stakeholders in keeping with Swedish political tradition. The Research Bill proposed to increase the public budget for research by approx. €127m every year over the period 2013-2016. This would have meant an absolute increase in the public R&D budget by approx. 421 million euro in 2016. This budget increase is divided over a four-year period starting in 2013. Starting in 2013, the bill projected an increase in funding by €180m., in 2014, it was estimated that the level of spending would increase by yet another €101m.in 2015 by €38.5m, and in 2016 by €100m. Life sciences were specifically selected for prioritisation. This was in part an emergency measure in order to compensate for Astra Zeneca's decision to reduce the size of its R&D investment portfolio in Sweden. It is also echoed in the shift in pattern of investment in the above mentioned public and private capital reported by the Swedish Agency for Growth Policy Analysis. Other areas of priority were energy, mining minerals, steel and sustainable building and planning. Research on space, forestry products and evidence based pre and primary school education were specifically mentioned priorities. The Bill confirmed government commitment to using strategic research areas as an instrument for capacity building in the aforementioned prioritised areas. Apart from the research priorities the bill specifically made provisions for the Swedish Research Council to make a special programme call aimed at younger scholars and recruitment of well renowned non Swedish scholars. Both programmes are now operational although the one for senior scholars will not be released in 2015.

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revised budget will have to be presented for the period beyond this. It is therefore not clear what if any of the proposals in the current budget will be implemented

The National Innovation Strategy aims to promote an innovation friendly climate through: (i) the creation of framework conditions for promoting innovation; (ii) access to competent capital to promote business interests and (iii) a sustainable physical and digital communication infrastructure. The Swedish Agency for Growth Policy Analysis has been tasked with monitoring and evaluating progress towards the goals outlined in the Innovation Strategy. The 2014 report,[20] used six composite indicators corresponding to the six goals outlined in the strategy: innovative regions and environments; innovative public sector; innovative firms and organisations; framework conditions for infrastructure and innovation; high quality research and higher education for innovation and innovative people. Each of these composite indicators is composed of a number of sub indicators. The report concluded that framework conditions in Sweden for enterprises are good and that Swedish firms have a high degree of innovation in their new products and services (see Chapter. 4 for more detail).

A number of important changes to Swedish research and innovation strategies came into effect in late 2013 and 2014. A key one is the implementation of a new approach to regional development inherent in the strategic agenda for innovation programme which seeks to promote public-private partnership for regional development and innovation. Another is the Development of the Knowledge Triangle Programme which is a collective term for a number of sub programmes including the now closed Key Actors Programme. The other sub programmes that come under this heading are: VINNMER,[21] which was a COFUND arrangement and has now been replaced by Mobility for Growth;[22] Verification for growth;[23] and development of the knowledge triangle. Each of these four includes an element of collaboration between universities and other actors, mobility and knowledge transfer. More information is provided on these programmes in Chapter 4.

2.3 National Reform Programmes 2013 and 2014

The Council identified a number of issues in its recommendation on the national reform programme for Sweden. Among these, two are related to research and innovation policy. One is that measures need to be taken to improve performance in education with particular attention to be given to reading, mathematics and science. The other is indirect and is related to the high level of household indebtedness linked to the price of housing. The first was a major issue in the recent national elections and the recent budget makes special provisions for measures to be taken to increase quality in the education system. Although the focus on education pertains exclusively to pre-school, primary and secondary education, it is important to the extent that this part of the educational system is the main infrastructure for economic development. The government's proposal takes its point of departure in Sweden's performance as outlined in the Pisa evaluation. The main measures proposed are: to reduce class sizes in order to increase responsiveness to student needs; to address the crisis at the level of availability of teachers by increasing the attractiveness of

[20] An English summary of this document may be found at http://www.tillvaxtanalys.se/en/home/publications/reports/reports/2014-09-30-swedens-innovation-climate-2014---indicators-for-the-national-innovation-strategy.html

[21] http://www.vinnova.se/sv/Ansoka-och-rapportera/Utlysningar/Effekta/VINNMER-Marie-Curie-Incoming/

[22] http://www.vinnova.se/sv/Var-verksamhet/Innovationsformaga-hos-specifika-malgrupper/Kunskapstriangeln/Mobility-for-Growth/

[23] This is also known as VinnVerifiering http://www.vinnova.se/sv/Ansoka-och-rapportera/Utlysningar/Effekta/VINN-Verifiering-2015/

the teaching profession (no concrete measures are mentioned as to how this would be achieved) and to ensure that measures are taken to secure the competence of the teaching profession. Further, the government has proposed to allow a greater portion of resources at the school level to be demand driven and to ensure that all schools have the prerequisites necessary to be good schools. The general nature of these provisions taken together with the current political situation suggests that there is little analytical merit in speculating what they would amount to. One of the more positive outcomes of the budget impasse is that the government has to consult with the opposition on the details of the operationalization of these plans. This process is now underway and there is an agenda for what issues will be tackled in spring 2015.[24] Little or no attention has been given to the problem of household indebtedness.

2.4 Policy developments related to Council Country Specific Recommendations

The country recommendations for Sweden for 2013 were: (i) that Sweden should continue to focus on a budgetary strategy that would ensure a 1% of GDP government surplus; (ii) attention should be given to the high level of household indebtedness; (iii) that declining rate of performance in schools as outlined in the Pisa report should be addressed and (iv) that the high levels of youth unemployment should be given policy attention. No significant policy developments have occurred or are proposed for dealing with household indebtedness beyond the increase to 15% risk-weight floor mortgage exposures already noted in council country report.[25] Section 2.3 above gives a summary of the policy proposals for addressing the school performance issue. The recent national elections and the subsequent crisis over failure to reach agreement on the 2015 budget has meant that the political situation remains turbulent despite the agreement among the political parties intended to facilitate minority rule. One of the issues of contention is how best to deal with youth unemployment. The ruling left and environment coalition appears to favour a solution to this problem which would require financing through increased personal taxation but have been unable to get a majority vote to support the taxation measures needed to realise this goal. No further changes on this issue are expected until 2016 when a revised budget would be presented and implemented.

2.5 Funding trends

The 2012 Research Bill is the point of departure for the funding trends which one may observe in Swedish research and innovation policy. In terms of the large picture, the situation is quite stable. A closer look at the Bill will reveal that there are some significant changes intended to correct some distortions in the current system (see Chapter 3 for an outline of the main points of the bill). Of these, the most significant with respect to funding trends is the decision to increase the share of institutional funding that is performance based from 10% to 20%. This would be done via a national evaluation exercise, the details

[24] Press release Överenskommelse om målstyrning och utvärdering i grundskolan http://www.regeringen.se/sb/d/19868/a/254157

[25] Although household indebtedness is not at first sight an R&I issue, in the Swedish context, it is seen as related because of its connection to low levels of disposable income and the straitened circumstances for private risk capital.

of which have only recently been submitted to the Swedish parliament (see Chapter 3 for more on this issue). Apart from the modifications to institutional funding, the bill proposed special attention to be given to internationalisation and the careers of young researchers. Not many of these changes have been implemented to date. Of those that have been implemented, the recommendation to intensify internationalisation and attraction of excellent researchers from abroad stands out as that which has received most attention thus far. Likewise, the pledge to increase the numbers of young researchers has also been implemented and a number of programmes targeting younger researchers are now underway including the Marie Curie COFUND programmes such as VINNMER[26] and the nationally funded career postdoc (INCA). VINNMER targets female researchers specifically while INCA is open to all persons who meet the eligibility requirements. VINNMER (now known as Mobility for Growth) has a budget of €13m for the period 2013-2017. Applicants are expected to get co-funded from their respective host organisations which would theoretically increase the budget to €26m but it is doubtful that the level of co-funding anticipated is ever realised since what is written in the application and what is negotiated locally varies depending on the host organisation and the unit within the host organisation which is responsible for the scholar. Special funding for recruitment of doctoral candidates was also provided for to be allocated institutionally. This funding was allocated as part of the general increased funding to research and doctoral training in 2014 (specific sum cited in Chapter 3).

Universities received no specific instructions to allocate more of the institutional funding to doctoral students so no such allocations were made. If one uses a finer grain of resolution, there are some details that may contextualise this situation. The first is that doctoral students represent the largest category of scientific employees at Swedish universities. This would imply that they already account for a significant share of the institutional funding. This remains true even after one factors in that a large percentage of doctoral students are funded via project funding. The reason for this is that many universities finance the last year of doctoral students' employment via their institutional grant because project funding has been, until recently, based on three year cycles - doctoral studies in Sweden takes four years to complete. Secondly, efforts have been made to normalise doctoral student employment by reducing the number of students that are employed on stipends and as such have a lower salary and do not have access to pension and parental leave benefits that come with a normal doctoral position. A classic example of this would be ERASMUS and Marie Curie funded doctoral students. Even H2020 Marie Curie funding remunerates students at a much lower rate than the €50,000 per year that is the norm for faculty funded doctoral students. Universities usually make local exceptions to the general rule in order to accept students funded in this fashion but the doctoral student unions have been largely unsupportive of this trend. Any extra funding that would have been allocated to research education would have gone to make adjustments of this type rather than to create new positions. If one takes the entire funding situation into account and the peculiarities of the funding model, it may well be that the differences in the wage levels represents a potential structural obstacle for mobility into Sweden. HEIs have an incentive to reduce exposure by accepting fewer ERASMUS and MC funded doctoral students. The major change in funding has been the performance based institutional allocation measure which has yet to be implemented (see Chapter 3 for more information).

[26] http://www.vinnova.se/sv/Ansoka-och-rapportera/Utlysningar/Effekta/VINNMER-Marie-Curie-Incoming/

A review of the 2014 annual report for the universities and university colleges would reveal that, since 2008, funding for research and research education is by far the fastest growing item in university budgets (Swedish Higher Education Authority, 2014). The report shows that there has been a net increase by 4% over the period 2008-2013 with income for research increasing from 53% to 57% of the total budget for universities. The pattern of distribution of this funding among universities attests to the high level of performance based funding in the system as 48% of all research funding is shared among four universities: Gothenburg, Uppsala, Lund and Karolinska (Swedish Higher Education Authority, 2014). 9% of funding to higher education in Sweden comes from private sources: this is the highest share among the Nordic countries. Among these top performers there is considerable variation in the size of the share of their research budgets which is performance based. For instance, 62.9% (Swedish Higher Education Authority, 2014) of Karolinska Insitute's research budget is based on performance based income whereas the comparative figures for Lund and Uppsala universities are 54.7% and 51.8% respectively (Swedish Higher Education Authority, 2014). The size of the variation between Karolinska and the others may be related to the fact that Karolinska does very little teaching. Data on EU Framework Programme participation suggests that the level of funding received remained fairly constant from 2011 through to 2013. However, it seems there was an increase in the number of participants in Framework Programme projects. As mentioned previously, Swedish participation in Framework Programme funding is somewhat hampered by differences in wages and overhead costs. According to the Swedish Higher Education Authority's annual report (2014), EU Framework Programme funding accounted for 3.5% of the total project based funding for research at Swedish universities. This is the national average but there is some considerable variation across universities. The report only gave an organizational level breakdown of the universities with the largest funding flows and among these Lund University is the largest recipient of European Union funding (4.3% of its project based funding came from the EU). The next closest performers in this category were Karolinska Institute (4.2%) and Uppsala University (4%).

2.5.1 Funding flows

As mentioned earlier, there was a net increase of resources to research at universities in 2013 as a result of provisions made in the 2012 Research Bill. According to Statistics Sweden, total expenditure was €3.7b in 2013 which is 3.8% of the total government budget. Relative to the level of expenditure in 2012, the expenditure in 2013 was unchanged, however the share of the budget that was allocated to HEIs increased to 50% of the total budget for public R&D.[27] It is nevertheless important to bear in mind that Statistics Sweden includes all municipal funding to the health sector (so called ALF funding, which is funding for medical education and clinical research) in its reporting on funding to universities and university colleges. Municipal funding for health care goes primarily to universities and other research performing parts of the public sector. For 2013, Statistics

[27] Two peculiarities of this count should be noted. One is that from 2011 Statistics Sweden includes the R&D budgets and R&D personnel costs from municipalities in the total R&D expenditure. This means that the budget may contain some underestimations as not all municipalities are able to provide data (see http://www.scb.se/sv_/Hitta-statistik/Statistik-efter-amne/Utbildning-och-forskning/Forskning/Forskning-och-utveckling-i-offentlig-sektor/244514/244522/301713/). The second peculiarity is that the total expenditure for R&D cited for universities and university colleges includes money allocated to the Swedish Research Council.

Sweden reported that total municipal R&D funding was €166m (Statistics Sweden, 2014). This figure is in itself an estimate because not all municipalities report in data. Funding flows to the higher education sector also include government financing of student loans which accounted for 15% of the funding reported as allocated to the higher education sector in 2013.

Business expenditure on R&D increased by €372m in 2013 as compared to figures for 2011.[28] The bulk of this R&D (78%) is performed in firms with over 250 employees; this is a 4% increase for the same category of firms in 2011. The total number of R&D personnel employed within the corporate sector in 2013 was 82,583 (52,800 person-years, or full-time equivalents (FTE)). This is a slight decrease from 2011[29] where the comparator figure was 82,749 (54,300 FTE). Roughly two-thirds of the corporate R&D was conducted by firms in the goods-producing sector, and roughly one third within the service sector. According to Statistics Sweden's report, the main differences in corporate R&D statistics over the years 2011 and 2013 are the change in the number of FTEs in firms with 50-249 employees, i.e. small and medium sized enterprises. Micro firms (10-49 employees) had an unchanged level of R&D employment in 2013 compared to 2011 and large firms registered an increase of 4%. It is possible that these shifts are due to market changes such as mergers and acquisitions or other types of more product related factors. However, the data is too little to provide lead for further investigation and the shift is too minor to warrant such investigation. Apart from performing their own research, many Swedish companies fund research at universities and research institutes. The Swedish Higher Education Authority reported that universities received a relatively unchanged share of their research budgets from Swedish companies during the period 2011-2013. In actual funding terms, the figure cited was circa €75m. This does not however include funding for doctoral students.

2.5.2 Project vs. institutional allocation of public funding

Since the 1990s Sweden has had a research funding system in which the larger share of funding (≥51% see data in table 2 for specific figures) to public research institutions and particularly universities and university colleges is allocated through competitive means (comprising project funding and institutional funding linked to institutional assessment). The 2012 Research Bill recommitted to a research funding strategy that is skewed towards project based funding to groups and individuals rather than organisations. Internationalisation and excellence were key points of focus (see Chatper 3 for overview of key initiatives). Additionally, institutional funding to universities has become increasingly performance based. In 2009 a performance based model for resource allocation was introduced in Sweden. The model allocates a part of the institutional funding (block grants) to HEIs or research and doctoral education (from 2014 20%) on the basis of two quality indicators: publications/citations and external funding. In 2013 the Swedish Research Council was given the task to propose a new performance based model on research funding that should include peer review instead of only indicators. As a preparation a report was produced (Quist et al. 2013) which presented an overview of some existing national evaluation systems (UK, all the Nordic countries except for Iceland, New Zealand,

[28] www.scb.se/Statistik/UF/UF0302/2013A01J/UF0302_2013A01J_SM_UF14SM1401.pdf

[29] 2011 is used as the year of comparison since this is the year for which there is verified data. Statistics Sweden conducts R&D surveys every other year on odd years. Data for even years are estimates- Additionally, R&D data from the research institute sector is reported as part of corporate (enterprise) R&D.

Belgium (Flanders), Netherlands). In December 2014 the Swedish Research Council delivered the full proposal to the government named Research Quality Evaluation in Sweden (Forskningskvalitetsutvärdering I Sverige - FOKUS). VINNOVA has also been charged with developing a system for evaluating outreach and impact from universities. VINNOVA intends to present the final proposal in 2016. The Swedish Research Council and VINNOVA have discussed the need for closer coordination between the two proposals.

Table 2. Basic indicators for R&D investments

	2009	**2010**	**2011**	**2012**	**2013**	**EU28 (2013)** **
GDP growth rate	-5.0	6.6	2.9	0.9	1.6	0.1
GERD (% of GDP)	3.42	3.22*(e)*	3.22	3.28*(e)*	3.21*(dp)*	2,02*(e)*
GERD (euro per capita)	1,142.8	1270.8*(e)*	1386.6	1464.9*(e)*	1,464.5 *(dp)*	539.2*(dp)*
GBAORD - Total R&D appropriations (€ million)	2,661.751	3,093.853	3,208.82	3581.645	3639.716	90 505.611
R&D funded by Business Enterprise Sector (% of GDP)	2.5	x	2.33*	1.94	2,36*	1.12% (2011)
R&D funded by Private non-profit (% of GDP)	0.09	..	0.1	..	0.07[30]	0.03e(2011)
R&D funded from abroad (% of GDP)	0.35	..	0.36	..	..	0.2*(e)* (2012)
R&D funded by Framework Programmes(€ million)			184	188	188	
R&D related FDI (€ million)			3406.4[31]			
R&D performed by HEIs (% of GERD)	25	26	27*		26	23.6% (2012)
R&D performed by Government Sector (% of GERD)	4	5	4	5	4*	12.2% (2012)
R&D performed by Business Enterprise Sector (% of GERD)	71	69	69	68		63.3% (2012)
Share of project vs. institutional public funding for R&D	58.4/ 41.6	54.7/ 45.3	55.2/ 44.8	54.4/ 45.6	55,1/[32] 45,3	N/A
Employment in high- and medium-high-technology manufacturing sectors as share of total employment	5.0	4.7	4.6	4.5	4.4	5.6
Employment in knowledge-intensive service sectors as share of total employment	50.3	50.6	51.2	51.5	51.7	39.2
Turnover from Innovation as % of total turnover	..	8.4	..	..	..	13.4 (EU-27, 2010)

* figures taken from Statistics Sweden

[30] Own calculation based on data from Statistics Sweden.

[31] Figures taken from Tillväxtanalys (2013) Forskning och utveckling i internationella företag 2011, Sveriges officiella statistik

[32] Figures taken from Swedish Higher Education Authority, Annual Report, 2014

2.5.3 R&I funding

2014 saw the mobilization of efforts within the Swedish funding system to address some longstanding deficiencies. One of these has been the perceived underperformance and underfunding of research in the humanities and social sciences. A major funding effort is now underway in this regard and this effort is being spearheaded by the Swedish Foundation for the Humanities and Social Sciences which has two major calls open this year; one which is directed at general social science and humanities research, and the other one which is directed at research on research (i.e. research on science policy, innovation and higher education). The first employs a bottom up approach while the second is a combination of thematic and bottom up. Both calls attempt to encourage SSH researchers to apply in teams and to include international researchers. A second issue has been the focus on challenge driven innovation. In this regard, two programmes are noteworthy of mention, one on transport and the other on social innovation. Investment in transport is considered to be a proxy indicator for assessing progress towards improving the framework conditions for innovation while social innovation is a specific area of priority identified in the National Innovation Strategy. Transport is treated as a proxy indicator for the framework conditions for innovation because of the importance of transport to growth.[33] In the 2012 Strategy for Innovation, the argument was posited that the globalized economy increased pressures and demands for planning and expansion of transport systems and for this reason transport planning, maintenance, etc. could be used as an indicator of framework conditions for innovation. VINNOVA has responsibility for innovation related investments in transport. Since 2009, VINNOVA has had a programme in collaboration with the Swedish Energy Agency, the Swedish Transport Administration and the automotive industry which is called Strategic Vehicle Research and Innovation (FFI). FFI has R&D activities worth approx. €100m per year, of which half is government funding. The focus areas in FFI are: Energy & Environment; Vehicle and Traffic Safety; Electronics, Software & Communication; Sustainable Production Technology and Transport Efficiency. The social innovation focus is most readily captured at the level of regional innovation policy outlined below.

It should also be noted that there is a special energy R&I programme which is based on the 2012 Government Bill on Research and Innovation for a Sustainable Energy System, managed by the Swedish Energy Agency. Following the 2012 bill, there have been five priority areas: a vehicle fleet independent of fossil fuels; a power system designed around renewable electricity; energy efficiency in the built environment; increased use of bioenergy; and energy efficiency in industry. The programme focuses on understanding the needs of users, disseminating R&D results, deploying technologies and services, building up scientific and technological knowledge and competence, and further increasing collaboration with different stakeholders at both national and international levels.

2.6 Smart Specialisation (RIS3)

After the reorganization of the regions described in Country Report 2013, it is now somewhat clearer how the regional innovation strategies and smart specialization initiatives will take form. Additionally the national innovation systems agency VINNOVA has since 2005 been promoting growth and innovation at the regional level primarily but not

[33] http://www.vinnova.se/sv/ffi/

exclusively through a funding program called VINNVÄXT.[34] VINNVÄXT, which was initiated in 2002, is now considered to be an instance of smart specialization. From its inception, VINNVÄXT was directed at regions. Projects are funded for up to ten years and funding can be as high as 1m euro per year. The eligibility requirements include: active collaboration among business, public sector and research performing organisations; a focus effort on an area in which the applicant region has a strong comparative advantage; and demonstrate how the programme will contribute to sustainable development and renewal. The latest call was in 2013 and three projects were funded: Smart Housing Småland; Paper Province, Karlstad and Geo-Life Region, VPX.[35] Each project has a budget of about €4m, half of which comes from the region and the other half from VINNOVA. VINNVÄXT regions are also required to participate in a number of supporting activities such as seminars, training, sharing of experiences and best practices, etc. There is a new VINNVÄXT call currently open. Additionally, the focus on smart specialization will be deepened considerably in the near future. One concrete manifestation of this is the Strategic Innovation Areas programme, which is a joint effort between VINNOVA, the Swedish Energy Agency and the Research Council for Environment, Agricultural Sciences and Spatial Planning (FORMAS). The programme invites private and public sector actors to develop a common agenda on tackling innovation in a specific area. Several regional actors in Sweden are participating in an INTERREG which focuses on transnational regions. In total Sweden is participating in 13 of these projects.[36] There projects are in part financed with EU structural funds and the total EU contribution is €985,483m. This funding will have to be matched by the different actors in the participating regions.

2.7 Evaluations, consultations, foresight exercises

A number of most important evaluations for the research and innovation policy area were completed in 2014 and early 2015. These are:

1. the Swedish Agency for Growth Policy Analysis' evaluation of progress towards the goals outlined in the National Innovation Strategy which was published in June 2014;[37]
2. Swedish Research Council's model for national research evaluation, FOKUS;[38]
3. Karlström and Svedberg's evaluation of the Institute Excellence Centre Programme;[39]
4. The Swedish Research Council's report on funding for research infrastructure;[40]
5. The Swedish Research Council's report on Guidelines for Open Access;[41] and

[34] http://www.vinnova.se/sv/Recycle-Bin/Insatsomraden/Starka-forsknings--och-innovationsmiljoer/VINNVAXT/
[35] http://www.vinnova.se/sv/Aktuellt--publicerat/Pressmeddelanden/2013/130626-Tre-nya-satsningar-far-VINNVAXT-finansiering/
[36] http://eu.tillvaxtverket.se/programmen/interregterritoriellasamarbetsprogram.4.703a861f1468c02714177fe7.html
[37] Tillväxtanalys, (2014) Innovationsklimatet I Sverige 2014. Indikatorer till den nationella innovationsstrategin
[38] https://publikationer.vr.se/produkt/forskningskvalitetsutvardering-i-sverige-fokus/
[39] http://www.vinnova.se/sv/Aktuellt--publicerat/Publikationer/Produkter/Institute-Excellence-Centres---IEC/
[40] http://www.vr.se/forskningsfinansiering/sokabidrag/vetenskapsradetsutlysningar/stangdautlysningar/internationalcareergrant.5.7e727b6e141e9ed702b100f2.html
[41] http://www.vr.se/4.1d4cbbbb11a00d342b0800021800.html

6. the Swedish Agency for Growth Policy Analysis evaluation of ALMI's support for small and medium sized enterprises.[42]
7. The Swedish Research Council's midterm evaluation of Linneaus Centres granted 2008[43]
8. The Future of Swedish Research: Career Structure and paths in Swedish Universities[44]

The reports on open access and infrastructure are taken up in Chapter 3. The summary of the evaluation of ALMI's support will be treated in Chapter 4 under innovation climate for SMEs. The substance of the monitoring of the National Innovation Strategy is dealt with summarily here and then in the other sections where specific issues are raised e.g. Smart Specialisation, Public Procurement for Innovation, etc. The National Innovation Strategy identified Sweden's poor showing in education and research quality as the two most pressing issues for policy attention. The Swedish Research Council was charged by the former government with the task of proposing a new model for performance based resource allocation at the institutional level and at the end of 2014 they produced a report to this effect. The government has received the report and is planning to send it for referral later in 2015 before any decisions will be made. The model proposed is called FOKUS (Forskningskvalitetsutvärdering i Sverige – Research Quality Evaluation in Sweden). The proposal comprises two parts; the first consisting of the evaluation model itself and the second part consisting of a calculation model that suggests how the evaluation results can be translated into resource allocation. The main purpose of the model is to be a driver of quality, i.e. to promote improved quality of research carried out at Swedish universities and university colleges and also to promote the contribution of high quality research to societal development. The model can be used for resource allocation and there are specific mechanisms suggested in the model to achieve this but the Council went to great lengths to argue that the model may be implemented without resource allocation consequences. The proposal is that the evaluation is conducted every seven years by 24 panels of international, national and Nordic referees. All research is to be divided into 24 research areas, which in turn consist of reporting units, one for each research area at each HEI concerned. The division is proposed to be disciplinary and is based on the Swedish National Standard for Research Subject Classification 2011 and how the HEIs classify their research according to that standard. The reporting units do not necessarily correspond to a particular organisational unit at a given HEI, but consists of the HEI's body of research in those research subjects that are included in each research area. The 24 research areas are in turn aggregated to five fields of research: Natural sciences and Agricultural sciences (NL), Engineering sciences (T), Medicine (M), Social sciences (S), Humanities and Artistic research (HK). What is included in each research area is determined by how the HEI classifies its research when reporting to the various government agencies involved. The weighting proposed in the evaluation is 70-15-15 with the highest weighting being reserved for the component scientific or artistic quality. The remaining 30 is divided equally between components quality enhancing factors and impact beyond academia.

The component quality enhancing factors is evaluated at the level of field of research against the criteria: potential for renewal and sustainability. The following factors are included:

[42] http://www.tillvaxtanalys.se/sv/publikationer/pm/working-paper-pm/2014-11-14-utvardering-av-almis-foretagsradgivning---utvardering-av-radgivningsverksamhet-till-etablerade-foretag.html
[43] https://publikationer.vr.se/produkt/midterm-evaluation-report-of-the-2008-linnaeus-centres/
[44] https://publikationer.vr.se/produkt/forskningens-framtid-karriarstruktur-och-karriarvagar-i-hogskolan/

- doctoral education and early career researchers
- collaboration and mobility within academia (nationally and internationally)
- collaboration, partnerships and mobility outside academia (nationally and internationally)
- integration of research and education
- gender equality

The impact component is assessed using criteria: reach and significance. HEIs will submit mainly qualitative material to assess impact beyond academia. This material will consist of case studies and a brief description by the reporting unit with information about strategies and resources for communicating results beyond academia and for promoting the use of research results beyond academia.

Another influential evaluation is that on open access publication strategies. Currently, most Swedish public funders of research have a mandatory requirement of open access publication. The open access issue was open for consultation with the research community up to November 2014. It is expected that the recommendations of this evaluation will take effect in 2017 if the government accepts the report. The details of this evaluation are outlined in chapter 3.

Karlström and Svedberg produced a report on the Institute Excellence Centre programme which was initiated in 2007 (call opened in 2005) and funded jointly by private enterprise, VINNOVA, the Knowledge Foundation and the Foundation for Strategic Research (participated up to 2009). Seven institute based centres received funding from this programme for a period of 6 years ending in 2012. The total budget of the programme was about 1 billion SEK (Karlstrom and Svedberg, 2014, p. 7) of which approximately one third came from private enterprise. The objective of the programme was that research institutes in collaboration with universities, university colleges and firms would create critical mass in areas that were strategically important for Sweden's future competitive advantage and growth. The focus areas selected were: Advanced Sensors, Multisensors and Sensor Networks; eco-efficient and durable wood-based materials and products; networked Systems; process Integration in Steelmaking; controlled Delivery and Release; imaging integrated Components; Fiber Optics; Casting Innovation (closed after mid-term evaluation in 2009.)

Karlström and Svedberg found that in general the programme contributed to improving research quality and internationalization among the research institutes. The collaborating firms, particularly SMEs, reported increased international competitive capacity and many of the firms were noted to have specifically used their collaboration with the institutes as part of their marketing strategy outside of Sweden.

3. National progress towards realisation of ERA

In the last three years Sweden has intensified its efforts at internationalization of the higher education and research sectors. The most significant developments in this regard are the international fellowships aimed at promoting mobility of young scholars. This effort is aimed at both attracting young scholars to Sweden as well as encouraging Swedish scholars to travel abroad. In 2014 nearly all Swedish public research funders had at least one call which was directed at promoting mobility among young researchers.[45] Since 2011, Sweden introduced a fee for students from non-European Union countries. Despite the fact that there were a number of exceptions to this new rule and a number of stipends were made available for such students, the effect of the new arrangement was that the number of international students reduced from 6000 to 1600. In 2012, the number of non-EU students increased by 19% (no figures yet available for 2013). The reduction in numbers of non-EU students has been compensated for by a marked increase in the number of students coming from other EU countries (60%). The net effect of the introduction of the fee system may be regarded as a setback for internationalization in higher education but a marked improvement in terms of aspirations for more mobility in the higher education sector within the EU.

3.1 ERA priority 2: Optimal transnational co-operation and competition

In addition to its participation in Joint Programming, Sweden has also been introducing a number of bilateral research funding collaborations which are intended to promote competition and transnational co-operation. The Swedish Foundation for International Cooperation in Research and Higher Education, STINT has had primary responsibility for this task for the past twenty years but during this time, transnational co-operation has been mainstreamed in the public research funding system. The most recent efforts in this regard are VINNOVA's Sweden-India programme on Embedded Systems which is a joint call between Sweden and India and involves private, public and research sector actors.[46] The budget for this call is €2m which will be divided among 3-4 projects. Collaboration with China has also been growing steadily both in the context of higher education and research.

A more longstanding transnational collaboration is the Nordic Minister's Council agreements on collaboration in research and education. Sweden, Denmark, Iceland, Finland, and Norway are members of this council and while Sweden, Denmark and Finland are EU member states, the other two Nordic countries are not. Collaboration on this level is divided among a plethora of initiatives and it is not within the scope of this report to provide an exhaustive list. In this chapter, a few examples from research cooperation will be highlighted. NordForsk is a funding agency under the Nordic Council of Ministers which takes care of research funding for Nordic projects. Currently, there are no open calls but there are ongoing programmes in a number of significant areas. These include the Nordic eScience Globalisation Initiative (NeGI) which has a total budget of about €14.8m of which €3.9m is distributed by NordForsk. NeGI focuses on e science on global challenges and

[45] See www.vr.se; www.formas.se; www.stint.se; www.fas.se.

[46] http://www.VINNOVA.se/sv/Ansoka-och-rapportera/Utlysningar/Kommande-utlysningar/Svenskt-indiskt-samarbete-inbyggda-system/.

consists of three Nordic Centers of Excellence, two within eScience in Climate and Environmental Research, and one within eScience in Health and Social Preconditions to Health.[47] These started in January 2014 and will be funded for five years. A second significant Nordic collaborative effort is the Top-level Research Initiative (TRI) which is the largest joint Nordic research and innovation initiative to date. TRI started in 2008 by a declaration of the Nordic Prime Ministers and was scheduled to run until 2014. It was divided into six sub programmes and the total budget was €53.5m.

- Effect studies and adaptation to climate change
- Interaction between climate change and the cryosphere
- Energy efficiency with nanotechnology
- Integration of large-scale wind power
- Sustainable bio-fuels
- CO2 - capture and storage[48]

3.2 ERA priority 3: An open labour market for researchers. Facilitating mobility, supporting training and ensuring attractive careers

The increasing priority given to international collaboration, the impact of the demographic shift on recruitment of labour in the research sector as well as a number of other factors has given rise to increasing policy attention to the issue of an open labour market for researchers. Sweden is no exception to the rule in this respect. Over the last decade, there has been an increasing focus on providing a more structured career path for researchers with the bulk of focus directed at doctoral and post-doctoral researchers. At the level of individual universities, this approach is hampered by a number of the more immediate problems arising from three key structural issues. One is the fact that Swedish universities are still formally a part of the civil service and administered according to the rules that govern the public sector in general. The second is the conjunction of increased reliance on performance based funding for research and teaching (comprising project funding and institutional funding tied to institutional assessment) and the third is the unique challenges to strategic planning that flow from the first and second issue. The Swedish Research Council's recent report on Career Paths in Universities concluded that the career path is longer now than earlier with researchers more often holding another position before the traditional early career positions such as postdoc. The report also showed that women tended more often to be hired in lectureships while men were hired as researchers. This was then argued to imply that women more often taught while a larger percentage of men did research.[49] This however needs to be nuanced with the additional information that the position researcher is one which is often given to individuals who are hired on project based funding. Employment regulations dictate that after two years this employee becomes permanently employed. The 'researcher' position is not a regular one and comes

[47] http://www.nordforsk.org/en/programmes/projects/nordic-information-for-action-escience-center-niasc http://www.nordforsk.org/en/programmes/programmer/escience/esticc-tools-for-investigating-climate-change-at-high-northern-latitudes

[48] http://www.toppforskningsinitiativet.org/en/om-toppforskningsinitiativet

[49] https://publikationer.vr.se/produkt/forskningens-framtid-karriarstruktur-och-karriarvagar-i-hogskolan/

with certain career risks even after becoming permanently employed. One of the most significant of which is that since the position does not formally include teaching duties, the career progression to professor may be hampered by lack of the requisite teaching experience.

The administration of Swedish universities under the civil service act implies that with a few exceptions, all the rules that apply to a Swedish civil servant apply to scientific staff at the university. The evolution of the modern university into a site where both knowledge and business creation are expected to occur implies that both universities and government are increasingly caught up in coming up with solutions to overcome the tensions between the new expectations of the organisation and the rule regime. There has been an incremental move towards autonomy but this is in principle limited given that universities are not in control of their budgets.

According to Swedish law, money for teaching and money for research cannot be interchanged. This means that if a university has got an excess of funding for teaching in its budget, this money may not be used for funding research and vice versa. Given that institutional funding for research covers only about 45% of the cost of the research actually performed at Swedish universities, this implies that even tenured staff who wants to perform research is dependent on raising funding. If a member of staff does not receive funding for research, this means that this person will have to teach to cover the costs of his/her salary. Two consequences flow from this situation, one is that there is a growing category of staff that is research only and secondly that universities are cautious about recruitment of scientific staff. The latter because research only staff have to be laid off once they fail to raise funding to pay their salaries. This process takes a year during which their salaries have to be paid by universities, which are therefore constantly caught in a dilemma that new funding may bring with it the need to recruit new labour which will at a later date put the ability to make strategic decisions in danger. Taken together, the above implies that there exists a gap between efforts to promote the careers of young scholars and the opportunities that universities can realistically offer for research careers beyond the post-doctoral period in the near future. The inflation in the number of professors since the shift away from the Chair system and the decline in student numbers pose additional challenges.

3.2.1 Introduction

The previous centre-right coalition government introduced a number of concrete reforms of the internationalization aspects of the Swedish public research system during its two terms of office. Among these, the most significant was the 2010 structural reform which initiated a process, the conclusion of which was intended to be full-fledged organizational independence of the universities and other higher education institutions (HEIs) from the public service system of governance. This reform which was popularly known as the Autonomy Reform[50] gave HEIs far-reaching autonomy in determining their own procedures for hiring and promotion of academic staff. The most radical of these has been the right to fast track the recruitment of staff at the professorial level once the person in question has already attained the rank of professor. This reform measure goes against the dominant trend of open competition but is intended to give Swedish HEIs better means to compete

[50] See En akademi i tiden - ökad frihet för universitet och högskolor http://www.regeringen.se/sb/d/12489/a/142310

internationally for talent (Government of Sweden 2008b). The 2010 Autonomy Reform was followed by a suggestion on the part of the then ruling government to invite universities to apply to leave the civil service and reconstitute themselves as public foundations (Government of Sweden, 2013). Very few universities have responded to this invitation and it is unclear if the new government will follow through on this proposal.[51] Generally, the response to those aspects of the autonomy reform that are already in force has been weak. The fast track recruitment process has been the most used of the new freedoms but this may slow down soon as a result of the fact that universities are still obliged to follow rules about gender equity when applying this reform. The dominance of male recruits in the first applications of the measure may make Vice Chancellors cautious about applying their discretion in the future unless the candidates are female. A major consideration for Universities in using these freedoms is that while they have greater freedom to act and plan strategically, their lack of control over their finances taken together with other leadership challenges make it difficult if not impossible to exercise this freedom.

3.2.2 Open, transparent and merit-based recruitment of researchers

Sweden has a long history of an official policy of open, transparent, merit-based recruitment. Over recent years, this system has been criticised for not functioning in the way intended for a number of reasons. Of these three are persistent and are recognised at all levels. The first is the system's inability to recruit female candidates to senior researcher positions, the second is the long delays that are almost endemic to the recruitment process and the third is the perception that Sweden is not attractive to foreign researchers primarily because of its reputation for being a high tax economy. Taken together, these three system flaws are said to hamper the public research system from accessing the best people. Universities have now been given the possibility of radically shortening the recruitment process at least on the professorship level and only for candidates who are already professors. The 2012 Research and Innovation Bill explicitly addressed the problem of internationalisation in relation to attracting excellent talent to Swedish universities and a number of measures have been introduced to promote this. One is the introduction of a fixed term reduction in taxes for incoming researchers.[52] There are still complications with this system, one of which is that it is not clear how widespread this information is among university administrators and how systematic the process for informing personnel about their eligibility. Another is that money has been allocated to universities to recruit outstanding international researchers. Universities have to apply for this funding from the Swedish Research Council. Interest in transparency and meritocracy have been for a variety of reasons almost entirely focused on gender despite the fact that the rules regulating this issue include other considerations. These drawbacks notwithstanding, there is a relatively high degree of transparency and commitment to merit based recruitment in Sweden particularly when compared to the EU28.

[51] See Alling, J. Ökad självständighet- en rapport till SUHF den 24 april 2014 http://www.suhf.se/publicerat/rapporter_1

[52] http://forskarskattenamnden.se/forskarskattenamnden/summaryinenglish/taxreliefforforeignkeypersonnel.483cc9f31134f01c98a800018147.html

3.2.3 Access to and portability of grants

The principle of money moves with researcher is not generally commonly known among Swedish researchers; this may in part be due to the, until recently, relatively low level of mobility of Swedish researchers. In 2013, the Swedish council for research announced two calls which explicitly included an element of portability. This was the Council Award for Professors[53] and the Grant for Excellent Young Researchers.[54] These calls employed eligibility criteria similar to those outlined by the European Research Council. The Grant for Younger Researchers has had two calls since its inception in spring 2013. Awardees are given up to 326,000€ annually for a period of six years. The grant is intended to give young researchers with potential an opportunity to develop their careers. The Council has allotted a total of 38 m€ over a period of six years to this particular call. In 2013, the total number of grants given in this call was 19. The decision on the 2014 call will be taken later this year. The Council Professor Award has had one call and this was in the summer of 2013, the second call has just closed. Ten projects were funded and each researcher who got the award will receive approx. €543,000 for a period of ten years. Only one project was awarded to the humanities and social science area.

There has been little discussion of grant portability or access. In the case of the latter, there may be several explanations but the most obvious is that there is no shortage of grants that Swedish researchers may apply for. The funding landscape is quite diverse in that, there are several funding agencies and many are fairly niched e.g. focused on a specific area of research[55], such as environmental research or health and social welfare. This diversity does not however translate into ease in getting grants since the funding landscape is quite competitive and the average rate of funding is somewhere between 10-15%.[56] Although the situation is changing, Swedish researchers still prefer to apply for funding nationally because the costs of research labour and overheads in Sweden makes most European Union funding rather unattractive. This is borne out by two types of data: number of Swedish researchers applying for EU grants and percentage of universities' funding originating from EU.[57] In principle, non-Swedish researchers may apply for almost any grant in Sweden as long as they partner with a Swedish organization. This organization

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53 http://www.vr.se/forskningsfinansiering/sokabidrag/vetenskapsradetsutlysningar/stangdautlysningar/radsprofessorprogrammet.5.7c02767a14a5b51525b3fbc8.html

54 http://www.vr.se/forskningsfinansiering/varabidrag/projektbidragungaforskare.4.7e727b6e141e9ed702bd042.html This call is directed at medicine, health, natural and technical sciences with one part of the money specially earmarked for psychology and health care research. The currently open call gives funding for 5 years.

55 See tables which provide a list of the major funders in Sweden at the end of Chapter 1

56 The percentage of successful applications varies with each program, call and funding agency, the general rule is that it is very competitive regardless of call. The Swedish research council's open call which is a bottom up annual call has a success rate of 14.4% (2014) but for the same call the rate of success for the humanities and social science area was 8,4% http://www.vr.se/nyheterpress/vrkommenterar/vrkommenterar/25miljardertillfriaprojektbidrag.5.26f56f72149ba1151e676446.html
FORTE's annual report for 2014 showed that the success rate was somewhat higher than 15% if one grouped all the calls together (17%)
http://www.forte.se/pagefiles/7283/FORTES%20%C3%85RSREDOVISNING%202014.pdf

57 See annual reports on universities Swedish Higher Education Authority, Universities and University Colleges, Annual Report 2014. The report shows a 7% increase in the percentage of research funding coming from the EU to Sweden from 2012 to 2013. The total figure reported was 5%.

would be the main grant recipient but can sub contract non-Swedish researchers who are not working in Sweden to perform work in the project.

As mentioned earlier, grant portability is available but it is unclear how widespread is the level of awareness of this feature in the research community. Apart from the relatively low mobility of Swedish researchers even within Sweden, the issue may be complicated by the fact that a large portion of individual and research group grants are negotiated with some input from the organizational budget. This is often because overhead costs in Swedish universities differ widely even within the same faculty, thus moving a grant between universities may require significant amount of re-negotiation. Despite the difficulties, it is both practically and theoretically possible to move grants between institutions as most grants are given to individuals although universities are formally expected to take responsibility for ensuring that the grant is managed properly.

3.2.4 EURAXESS

In Sweden, the EURAXESS network is represented by a website portal, launched in mid-2011, designed to provide information about researcher mobility. The website is connected to a network of 50 local nodes at universities and other higher education institutions, research councils, research institutes and firms. The administration of EURAXESS in Sweden lies with the Swedish Agency for Innovation Systems (VINNOVA) and the Swedish Research Council, the Swedish Research Council for Environment, Agricultural Sciences and Spatial Planning (Formas) and the Swedish Research Council for Health, Working Life and Welfare (Forte)[58]. The EURAXESS network is thus not subject to any national coordinated policy effort but rather administered and sustained by these research councils and the participating institutions. EURAXESS did not figure directly in discussions about researcher mobility in the latest Research Bill.

One potential explanation for this is the fact that researcher mobility has long been integrated in Swedish research policy. There is even one public research foundation that is dedicated to mobility (STINT) and all research funders do have instruments directed at mobility. Mobility however is not an isolated issue. Researchers have to feel that their chances at a career after return are not impeded by their absence. This is an issue that must be addressed at the level of HEIs, not at the level of government. Apart from career related issues, there are issues related to family policy and local customs which determine researcher mobility. The situation has improved in terms of the numbers of researchers willing to engage in some mobility during their post- doctoral and doctoral periods but if one considers the amount of funding available for this on the national and European Union level, the supply outstrips the demand in Sweden.

3.2.5 Doctoral training

There are no policy efforts on national level in Sweden that are tailored to directly address the Innovative Doctoral Training Principles. However, doctoral training in Sweden is not easy to adapt to European models for a number of reasons. The most important of which is that doctoral students are regarded as junior researchers in Sweden. This means that they are salaried university employees. The Swedish government introduced in the 1990s a

[58] Forte was previously named the Swedish Council for Working Life and Social Research (FAS).

reform which made it impossible to admit students to the doctoral programme unless they were funded for the entire period of their doctoral work, which is four years (Chapter 2 provides detail on the funding situation for doctoral students). This taken together with the reduction in institutional funding has meant that a vast majority of Swedish doctoral students are project workers, i.e. they are funded from grants for which their supervisors are responsible. Although working conditions, rights, etc. are regulated through university and union rules, the employment situation varies for doctoral students within universities and between universities.

Doctoral work is an integral part of the Swedish public R&D effort and consumes a significant share of the governmental R&D appropriations to the academic sector (Jacobsson and Rickne, 2004). This is directly related to the fact that doctoral work is not classified as training but as research and that doctoral students are employed. A doctoral student in the humanities and social sciences will earn a gross annual salary of approx. 33,000 euro and will cost the university approx. 50,000 euro. Students in the engineering sciences will cost slightly more. These figures both explain why doctoral work accounts for so much of the public R&D budget and the relative lack of interest in Swedish doctoral students to migrate to other parts of the EU to do their doctoral work. On the positive side, it has also meant that traditionally, Swedish doctoral programmes are rather attractive to both EU and non-EU students.

Content and quality in doctoral programmes are the responsibility of the faculty and department but there are national evaluations which are performed by the Swedish Higher Education Authority. The next evaluation is scheduled for fall 2016[59] and a pilot will be conducted in spring 2015.[60] The evaluation will focus on the quality of the education, working environment for the doctoral students and will be comprised of interviews and a self-evaluation to be submitted by the universities.

3.2.6 HR strategy for researchers incorporating the Charter and Code

There are no coordinated efforts on national level (government or agencies) to enable the implementation of the HR Strategy for Researchers. Personnel policies are regulated by universities in collaboration with unions. Although the conjunction of the pressures of funding, evaluation and increased workloads suggest that universities may well need to take personnel issues more seriously than they currently do, there is little evidence that this is a priority beyond the standard arrangements.

3.2.7 Education and training systems

There is some general concern in Sweden about the attractiveness of STEM subjects particularly to the female population but as yet there are no major policy initiatives directed at this issue. Traditionally, the Swedish education system has been very student focused and even more so in the last decade where pedagogic innovation such as 'problem based learning' etc. have been integrated in undergraduate and postgraduate programs.

59 http://www.uka.se/utbildningskvalitet/utvarderingavforskarutbildningar.4.5bb4875214acdd3d8c8181ad.html

60 http://www.uka.se/nyheter/testavnyutvarderingsmodellforforskarutbildning.5.3673205e14acd5ce45931fb5.html

There is a great deal of focus on independent problem solving, initiative taking and critical thinking. These aspects are integrated already in the primary and secondary school education. In fact, the levels of expectation on this front are so high and taken for granted that it has often been a problem when students from other backgrounds are integrated into the system.

A number of initiatives have been introduced to promote excellence in education. There was a teaching excellence programme which ran up to 2009. Universities and university colleges were invited by the then National Agency of Education (Högskoleverket) to apply to have one of their programmes deemed excellent. Applications were evaluated by an international committee. Unlike Centres of Excellence for Research, no financial incentives were provided to those programmes that achieved the label 'excellent'. The programme appears to have been discontinued in 2009. No rationale is given about the closure but the 2009 evaluation mentioned that there were few applications and the international panel attributed the low number of applications to the absence of financial incentives. In the absence of the former, the programme operated more like an accreditation or quality assurance programme. This may have reduced its value given the existence of several other more accepted accreditation schemes.

STINT has been funding mobility among teachers in higher education as well as student exchanges in order to promote excellence in higher education. This programme is divided into two generations and started in 1999. The first generation was called 'Excellence in Teaching' (1999-2013). An evaluation of 'Excellence in Teaching' is available but it only covers the period 2000-2006.[61] The second generation of 'Excellence in Teaching' is called Teaching Sabbaticals.[62] More than a hundred teachers have participated in this programme since its initiation.

In the 1990s, entrepreneurship education became a specific area of interest and since then these programmes have proliferated. In addition to the business plan courses normally run by the Innovation Offices at universities, there are specific programmes in entrepreneurship at most universities. The most successful and well regarded of these programmes is the Chalmers School of Entrepreneurship.[63] Additionally, there are entrepreneurship electives available in all types of tertiary education programmes and in some faculties at some universities, it is compulsory for doctoral students. There is no explicit focus on employability of graduates on the level that exists in Australia or the UK but since 1997 in conjunction with the revision of the university Act to include the third mission, there has been a focus on skills in tertiary education. Teachers are required to ensure that all courses give students the opportunity to put the theoretical aspects of their education in practical context. This is usually dealt with by bringing in lecturers from firms, public sector, etc as relevant. Increasingly, some programmes are moving towards integrating internships.

[61] http://www.stint.se/1/242

[62] Teachers have to be nominated by their universities for the sabbatical and the application must include information about how the university intends to use this in their own strategic development as well as the courses that the nominee can give. STINT has a number of selected partner universities to which nominees may travel. About 10 such sabbaticals are given per year and teachers may also get funding for family members to accompany them. The duration of a sabbatical is one term.

[63] http://www.entrepreneur.chalmers.se/

3.3 ERA priority 5: Optimal circulation and access to scientific knowledge

K2, a centre for research and collaboration on Collective Traffic is another example of recent initiatives in increasing circulation and access to knowledge. The centre is national and started in 2013, it is located at Lund University and its objective is to renew research on collective traffic through collaboration between researchers and industry in collective traffic. The intention is that collaboration would occur at every stage in the research process. The initial phase of the centre (2013 and 2014) is financed by Formas, the Swedish Traffic Authority and VINNOVA. Additional funding comes from Västra Götaland's region, Stockholm County Council, Region Skåne, Lund University, Malmö University College and the Swedish National Road and Transport Research Institute (VTI). This initiative was due to be evaluated at the end of 2014.

The Swedish Foundation for the Humanities and Social Sciences Foundation has introduced a funding instrument called FLEXIT which is intended to facilitate knowledge exchange between the business and public sectors and humanities and social science research. The programme allows for funding for a period up to three years, and consists of 75% research and 25% service, first at the host establishment and thereafter at the HEI department. The research council funds salary costs and other expenses relating to the research, while the host establishment pays salary for the remainder of the position and bears the costs of office workspace, the customary office infrastructure and use of various benefits at the workplace. The host establishment is the employer, and appoints a contact person for the researcher, who works on the premises as an in-house researcher but is also expected to retain and develop contacts with academia. In the last year of the project, it is expected that the researcher will be based at an HEI department, continues to carry out the research and maintains contacts with the host establishment.[64] See also Chapter 4 for initiatives on circulation and access to scientific knowledge.

3.3.1 e-Infrastructures and researchers electronic identity

The initiatives on EU level to build up research infrastructures for the facilitating of dissemination of data and results (e.g. European Social Survey, CESSDA, SHARE) are supported by the Swedish government who take active part as members in these initiatives and thus secure the access for Swedish researchers to them. In 2015, the Swedish basic science research council in collaboration with Forte and Formas have introduced a common e platform for research applications called PRISMA. These platforms are connected to ORCID and SWAMID. PRISMA is currently being tested as the first set of calls will be handled through this platform Spring, 2015. There are already signs that there will need to be some re-adjustments before the platform is fit for purpose. The intention is that PRISMA would be able to allow researchers to access and cross reference data they upload such as CV information. This is of course limited to the councils that are part of this scheme.

[64] Details may be found at: http://www.rj.se/en/Funding-opportunities/2014/Flexit-Call-2015/#sthash.jBUNKn2l.dpuf

3.3.2 Open Access to publications and data

In order to promote open access to publications, many public research councils are now including funding for making publications open access in grants. This is a follow up to the introduction of mandatory requirement to make research results open access which many Swedish public research councils have introduced. The 2012 Research Bill initiated a process of institutionalising the principle of open access in the Swedish public R&D system by giving the Swedish Research Council and the National Library the task of developing structures and "national guidelines" for access to research results and research data. The draft of this policy is now available and was circulated for comment by public authorities and the research community between the 10th October and 2nd November, 2014.[65] The policy is intended to come on line from 2025. The main provision of the policy is that all research funded by public money should be published immediately in open access (gold access)[66] and have a creative commons license. This includes books, papers and artistic works. The policy also provides for open access to data collected in publicly financed projects. The details of the implementation of the arrangements outlined in the bill are not outlined and it would appear that this would be handled by universities themselves.

Since 2010, the Swedish Research Council, the Swedish Research Council for Environment, Agricultural Sciences and Spatial Planning (Formas), the Swedish Council for Working Life and Social Research (FAS),[67] the Swedish Foundation for the Humanities and Social Sciences Foundation (RJ), the Knut and Alice Wallenberg Foundation (KAW) require that scholars funded by them publish their results open access. Almost all Swedish universities and higher education institutions have open, searchable databases where publications are listed and in many cases online versions of publications are openly accessible. Currently about 10% of all published articles from the Swedish research community are in green open access while about 9% are available in Gold open access, about 57% of all Swedish scientific publications are available in some form of open access arrangement. These figures are slightly above the EU28 average.[68] It is important to note that the open access issue is not simply about making information that is paid for with public money freely available to the public. In the context of RI policy, other factors play significant roles. .

65 http://www.vr.se/omvetenskapsradet/regeringsuppdrag/regeringsuppdrag/nationellariktlinjerforoppentillgangtillvetenskapliginformation/kommenteravetenskapsradetsutkasttillnationellariktlinjer.4.70a7940b146b8f93794b3d6c.htm

66 There is increasing evidence that scientific disciplines differ in terms of their preferences for open access arrangements.

67 FAS has since changed its name to Forte

68 Open access figures taken from Archambault, É et al (2014) Proportion of Open Access Papers Published in Peer-Reviewed Journals at the European and World Levels—1996–2013 available at http://science-metrix.com/files/science-metrix/publications/d_1.8_sm_ec_dg-rtd_proportion_oa_1996-2013_v11p.pdf

4. Innovation Union

The competitiveness of Sweden's industry is largely based on its strong R&D and broad innovation effort. The business sector's R&D expenditures represent 2.9% of net sales in manufacturing and 0.6% in services (SCB, 2011b, pp. 14 ff.). As noted earlier, business expenditure on R&D (BERD) for 2013 amounted to 2.3% of GDP. BERD has traditionally been high, but has decreased from a peak of more than 3% around 2001. According to the Innovation Union Scoreboard (IUS), Sweden is the second leading European country next to Germany in terms of innovation performance and still ranks first in terms of R&D intensity (IUS, 2014). This record is however largely due to the efforts of about 1% of Swedish firms and Sweden's continued dependence on these firms is worrying because of their small number and increasingly international ownership. More importantly, there are signs that the level of investment in R&D among these firms has decreased from 3.21% in 2001 to 2.36% in 2013. The last two years have witnessed a stabilisation in BERD and government investments have been increasing.

Sweden produced a National Innovation Strategy in 2012 and this is still the guiding document for innovation policy (Government of Sweden 2012). This strategy outlines three areas of focus: good framework conditions (e.g. open and free trade, stable public finances, research and education); public procurement as a route towards increasing demand (e.g. public tenders, regulation) and direct intervention (e.g. demonstration and test beds, public funding of innovation and entrepreneurship incubators, clusters and networks). The majority of the measures mentioned in these areas of focus have existed prior to the creation of the innovation strategy. The Swedish Agency for Growth Policy Analyses has a standing assignment to provide annual monitoring on the national innovation climate. The 2014 report identified the following strengths and weaknesses. Swedish companies are reported to have a high degree of innovation in products and services, there is an increasing number of international doctoral candidates and the framework conditions for firms are good. Four areas were identified as requiring urgent attention: majority of Swedish companies with a procurement contract showed no innovation activity at all; Swedish universities were declining relative to counterparts in comparison countries with respect to research quality; declining results in the Swedish education system and level of value added in exports is not developing at a similar rate to that in other countries.

Sweden changed government in 2014 and the new regime presented its first budget on 23 October 2014. This budget failed to acquire the majority vote necessary for its implementation. A subsequent political compromise known as the December agreement will allow for a new presentation of the budget in 2016 but most political commentators believe that many of the flag ship policies will not receive the opposition's backing. The most noteworthy aspect of the budget impasse for research and innovation is that the majority of taxes that were proposed in the original budget as measures to finance government expenditure were not approved. Little is expected to happen with respect to these issues in the interim.

4.1 Framework conditions

Sweden has a high-performing business sector with a relatively large number of innovative, export-oriented, internationalised firms. These firms operate in a diverse industrial sectors ranging from telecommunications equipment, pulp and paper, chemicals

to mining, pharmaceuticals, and electrical goods. Swedish firms also have a large and increasing presence in services sector which contributes a comparatively large share of GDP. The OECD's country report for 2012(OECD, 2012) and the Swedish Agency for Growth Policy Analysis evaluation of progress towards the 2012 Innovation Strategy (Tillväxtanalys, 2014) converge on the finding that an increasing share of Sweden's manufacturing firms are moving into services. The recent downsizing of Astra Zeneca's research facilities aside, large multinationals such as ABB and TetraPak continue to site significant portions of their production and research facilities in Sweden. Swedish RI policy is currently biased towards a supply side approach. This is in part a result of efforts to reduce dependence on the large multinational companies that have traditionally dominated the Swedish economic landscape. A second reason is that as in the rest of EU28, Sweden has committed to an economic transformation in which knowledge plays a key role. This transformation requires a re-fitting of extant institutions and competences as well as the introduction of new infrastructure and competence. These investments are of the type that are traditionally public. This being said, more can be done in Sweden to introduce better alignment between the supply and demand aspects of RI policy.

The Swedish Agency for Innovation Systems (VINNOVA) is the main policy actor for implementing the National Innovation Strategy. VINNOVA reports to the Ministry of Enterprise and is charged with the responsibility of promoting sustainable growth by improving the conditions for innovation, as well as funding needs-driven research. VINNOVA has an annual budget of approximately €283m. VINNOVA also coordinates with other actors in the innovation system such as the other funding agencies and is particularly charged with coordinating with the agencies for energy and transport.[69] In addition to VINNOVA, there are a number of actors that work with innovation related functions such as business support, patenting, financing, etc. Of these, ALMI is the largest publicly funded actor charged specifically with promoting business development. It does this through a portfolio of services ranging from loans, mentorship, incubator facilities and business support. Although ALMI is undoubtedly the largest actor of this kind, the system for support to firms in Sweden is populated with a number of such actors. A recent report by the Swedish Agency for Growth Analysis mentions at least six other such actors although differing in size and operating at different levels from ALMI. ALMI appears to focus quite heavily although not exclusively on the regional level. Additionally, the Swedish Energy Agency has a business development unit which provides business advice and loans to firms working with new and emerging energy technologies. VINNOVA also funds initiatives in this area. The Swedish Agency for Economic and Regional Growth (Tillväxtverket) is a third actor charged with working with framework conditions at a coordinating level. Their brief is to promote growth at the regional level by providing support and enabling conditions for companies. In addition, Tillväxtverket is the actor in charge of coordinating with EU Structural Fund programmes. These three actors form the core of the agencies working with framework conditions for innovation in Sweden and they do so in coordination with their Ministries and a number of other actors.

[69] The transport and energy agencies have substantial research budgets which they disburse directly. These agencies fund and perform research themselves. Additionally, they often co-fund with other actors such as VINNOVA, the Swedish Research Council, Forte and FORMAS. An example of a co-fund arrangement is the FFI programme on strategic vehicle research and innovation. The Swedish energy and transport agencies are co-funders with VINNOVA and the private sector in this programme.

VINNOVA is currently prioritising a general innovation awareness programme which is aimed at specific target groups.[70] These are knowledge triangle assemblages or partnerships consisting of public research organisations, firms, and public sector actors). Some of the key initiatives in this programme include infrastructure for demonstration and testing which is one initiative in the Research and Grow (Forska och Växa) and VINNVERIFIERING which is a programme that funds proof of concept. Yet another is the programme for investments in innovation in transport (FFI) which funds collaborative research between the automotive industry and universities. This initiative is reinforced by the Research Infrastructure Fellows (Nyckelpersoner för forskningsinfrastruktur) call spearheaded by the Swedish Foundation for Strategic Research (a public research foundation).[71] The latter is a competitive research call which is intended to provide support to those researchers in charge of research infrastructure to make the research infrastructure widely available to other actors and to engage the business sector in making use of this infrastructure (Tillväxtanalys, 2014). The total budget available for the call is €26m and individual projects can get up to €1.6m.

4.2 Science-based entrepreneurship

Sweden has been focusing on science-based entrepreneurship for at least a decade and the first science parks were constructed in the 1980s. This earlier generation of investments in which science parks played a pivotal role focused on improving collaboration between large firms and universities. Since 2000, science parks have not been a focal point in Swedish science based entrepreneurship and many of the existing science parks such as IDEON and Chalmers have changed focus from large firm-university collaboration to university start up incubation. This fits with the last two decades of economic growth policies which have been largely focused on an incremental industrial restructuring to decrease Sweden's dependence on the large multinational firms such as Ericsson and ABB.

An important framework condition for science based entrepreneurship in Sweden is the fact that Swedish researchers enjoy the right to own the intellectual property arising from their research. Sweden is one of the few EU 28 countries that still retains this rule despite several government inquiries to investigate the evidence for shifting to the dominant approach in Europe, which is to give universities some type of ownership of intellectual property[72]. Both research and casual evidence continue to support the view that researcher ownership is not an obstacle to commercialisation (Borlaug and Jacob, 2013; Wigren and Wahlbin, 2007; Dahlstrand and Jacobsson, et al. 2013) at least in the Swedish case. Swedish actors working with innovation support at the university level however are firm supporters of the policy line which favours a transfer of ownership to universities. Although Sweden has not formally changed the property ownership rules to favour universities ownership, Swedish universities are obliged to provide an infrastructure to support dissemination and/or commercialisation of research results created by their employees and students. This would include services such as advice and expertise on patenting,

[70] http://www.vinnova.se/en/Our-acitivities/Innovativeness-of-specific-target-groups/
[71] http://www.stratresearch.se/sv/Press/2014/Nyckelpersoner-for-forskningsinfrastruktur/
[72] In cases where researchers do commissioned or contract research for business, the contract will stipulate eventual IPR ownership issues arising from the research. If no such provisions are made, the researchers own the rights to the research results.

information about how to start a company, etc. There is a proliferation of initiatives and programmes aimed at providing these types of services or funding for universities to provide such services. Most Swedish universities have some type of incubator and support infrastructure for science based entrepreneurship. Currently, there are a number of important initiatives in this regard.

One of the more significant is the university and university college strategic outreach programme (Knowledge triangle development) which was initiated in 2013 by VINNOVA. Knowledge triangle development is properly speaking a meta programme in so far as it is not a specific programme but a collection of initiatives all focused on collaborations among public and private sector actors with universities as key partners. Knowledge triangle is merely the policy incarnation of Triple Helix and is one of VINNOVA's strategic areas of focus. In December 2013, the winners of this call were announced. The 18 winning applications included 28 higher education and research entities, a new call will be announced in 2014. The majority of the applications included plans for mapping existing outreach activities, scaling up and increasing student involvement. The total amount of funding distributed for the 2013 call was about €9.4 m.

A more limited in scope initiative which is directed towards small and medium size firms is the Research and Grow Programme (Forska och Växa) which offers financing to companies with up to 200 employees for either pre studies or development projects. The programme is currently focused on one priority area, digital health and the upper limit for how much funding can go to a project is €523,392. Companies that are one year or younger may apply for full funding for their projects but can apply for no more than €52,339, any funding above this level will have to be matched by funding from the company itself. Older companies must cofund the project. The projects must conform to a particular profile in that they should be high risk, innovative, growth driven and of strategic importance to the company's growth and development.

4.3 Knowledge markets

The existence of the professor's privilege means that there is little utility in creating centralised arrangements for dealing with intellectual property. Instead Sweden has chosen a decentralised approach in which the emphasis has been on ensuring that there is widespread knowledge of intellectual property support services. In addition, there is a mixture of public and private providers in this sector. For example, university employees and students have access to legal and other support mechanisms for patent creation, licensing, etc. through the innovation offices[73], the holding companies at universities, etc. Private citizens and companies have a similar array of services available to them through ALMI, CONNECT[74] and other similar arrangements. There are several events annually spread out all over the country at which these entities present their services to the public and business community. The national patent agency has a search engine which is available both publicly and on a fee basis for patent searches, and similar type services.[75]

[73] Innovation offices were introduced in 2009. There are 7 of them and they are located at universities. They provide advice and support services to researchers on licensing, patenting, contract research and other issues related to knowledge transfer The innovation offices vary slightly in terms of their activities, many of them work in close collaboration with other actors such as CONNECT, ALMI and regional development agencies.
[74] CONNECT is a business angel network see http://connectsverige.se/
[75] http://www.prv.se/sv/vara-tjanster/prv-interpat/

4.4 Knowledge transfer and open innovation

All Swedish publicly funded research performers have been legally obliged to engage in knowledge transfer since 1997;[76] however, this rule has been revised to emphasise knowledge transfer to support innovation. There is a great deal of activity on this front at Swedish universities in particular. However, many of the standard proxies and indicators cannot be provided because of the way in which these activities are categorised or as a result of other peculiarities in the Swedish system. Three of the most relevant framing conditions that undermine the possibility of providing standard indicators on knowledge transfer are (i) professor only exists as an academic position in Sweden, it is not a title. Thus, one cannot have professors employed at firms and if they are perhaps on a part time basis, their employment there will be formally not as Professor (ii) Swedish researchers not universities own intellectual property arising from their research results, this implies that patent applications and firm formation done by Swedish researchers even within the context of the university are done in their capacity as private individuals and does not feature in the university's reporting on knowledge transfer, etc. and (iii) universities collaborative agreements with firms are not recorded as a separate category from other project funding obtained by the university. Thus, one may obtain an estimation of how much corporate funding went to Swedish universities but not whether it was specifically for a collaborative agreement. This last issue is further complicated by the fact that universities and firms are often co applicants for project-based funding from research councils and foundations. The firm's own contribution to this agreement in such cases is often embedded in the application and not visible at the level of funding. These peculiarities are also problematic for the Swedish government itself to track knowledge transfer and the increased promotion of open innovation chains has made it doubly so. A classic manifestation of this is the firm policy belief that there is an innovation paradox while the empirical evidence suggests otherwise. An important contributing factor to this is the inability of government to ascertain for itself, the extent of university-industry collaboration generally and particularly the level of patenting and firm formation arising from academe.

This paragraph will focus on reporting on the indicators that do exist and on suggesting some potential proxies. Knowledge transfer as measured in exchange of personnel between firms, the public sector and universities may be tracked through the categories of adjunct personnel and industrial doctoral students. This is only a partial indicator since it only tracks inflows to universities from other sectors not outflows. This is in part due to the fact that most of the programmes aimed at promoting inter-sectoral mobility have been focused on firm-university mobility rather than the other way around. The 2014 annual report for the higher education sector showed that number of adjunct professors and teachers at universities in Sweden in 2013 was 1200 and they represented 300 FTE. Of these 46% were full time and thus employed as professors, 20% were lecturers, adjunct (personnel without a PhD) accounted for 30% and another 3% were described as simply 'other research personnel. Industrial doctoral students- probably represent the largest and most fluid exchange of personnel between academe and industry, 4% of new doctoral

[76] SOU 1996:70: Samverkan mellan högskolan och näringslivet. Huvudbetänkande av NYFOR-kommittén (Document proposing amendment to the University Act) The university act may be found at https://www.riksdagen.se/sv/Dokument-Lagar/Lagar/Svenskforfattningssamling/Hogskoleforordning-1993100_sfs-1993-100/?bet=1993:100 *SFS 1996*:1392

students were industrial doctoral students in 2012 and this increased slightly to 5% in 2013.[77]

Recently, there have been attempts to promote flows of personnel from academe to industry but these are not as numerous as the other way around. One such programme is FLEXIT which is a pilot programme to promote exchange; it targets young researchers from the HSS area. FLEXIT started in 2010 and 10 researchers have been placed since then. There is a new call for 2015.[78] The Knowledge Foundation is a public research foundation which was set up specifically to promote collaboration between the new university colleges and firms has two new programmes focused on knowledge exchange: Expert Competence for Innovation: Stage One.[79] This funding call is directed at university colleges, research institutes and firms and is intended to provide funding to create educational offerings that would meet the needs of the company. The intention is that this educational offering would be grounded in an existing critical mass of research in the area. It is expected that successful applications would receive about 420,000 euro each to prepare, evaluate and conduct a pilot. A second initiative in a similar vein from the same funder is the Strategic Knowledge Enhancement (Strategisk Kunskapförstärkning)[80] which offers university colleges funding to assist in the recruitment of personnel from industry or elsewhere in order to complement the university's research profile. Funding available for this end is about €120,000 per year for up to three years.

Apart from these programmes, which focus on knowledge transfer through intersectoral mobility, there are more general knowledge transfer programmes focused on the Open Innovation model. The regional growth programmes such as VINNVÄXT (described in Chapter 2) have been the major platforms for knowledge transfer and open innovation as well as the Competence Centres and Centres of Excellence for Innovation. Competence centres was the first generation of programmes intended to promote collaboration between firms and academe. These began sometime in the 1990s. According to VINNOVA's data, the first generation of competence centres ran from 1995-2008 and represented a joint public-private investment of €550 m. Apart from their scientific production, VINNOVA claims that 16 centres contributed to the formation of 43 new firms and 20 centres filed for a total of 164 patents (VI 2006:16). The second generation competence centres were called Berzelii centres and were a VINNOVA-Swedish Research Council funding collaboration. The Berzelii centres reflected the funding trend of the time and differed from the previous generation in that they focused on a strong connection between scientific excellence and large innovation potential. The emphasis was on research in the absolute international frontline and as such there was a much stronger element of this funding compensating for market failure in the classic research policy argument. Additionally, these centres became integrated in the larger centre of excellence programme run by the Swedish Research Council known as the Linnaeus centres. Four centres were funded in the first round and were evaluated in 2013. The evaluation focused on scientific performance and innovation potential. The results were mixed with one centre emerging as a clear leader on all indicators but all the centres performed well in scientific quality but innovation potential was quite mixed (Reese et al 2013). This may in part be due to the

[77] Swedish Higher Education Authority (2014) Annual Report.

[78] See Chapter 3 for more information on FLEXIT

[79] http://www.kks.se/verksamhet/Kompetensutveckla%20p%20avancerad%20niv/Expertkompetens%20för%20innovation.aspx

[80] www.kks.se/.../Strategisk%20kunskapsförstärkning%2014/Utlysning%20

fact that the focus was on frontier research and firms may not be ready to invest at the point in time that the invention emerges.

4.5 Innovation framework for SMEs

Traditionally Swedish industrial policy has favoured large firms but the emphasis on high technology growth markets has brought increasing focus on small and medium sized firms. According to Statistics Sweden, the bulk of Swedish R&D is still done within firms with 250 or more employees but in 2013 there was an increase in the number of R&D employees in firms with 50-249 employees. 99% of Swedish firms have fewer than 50 employees and they account for more than 50% of the employees in the private sector (1.6m persons).[81] One way of making sense of the innovation framework for SMEs in Sweden is to divide it into two interconnected but separate categories, support for science based firms and support with a more regional development focus. In both instances, there is a proliferation of initiatives to provide business support, loans and other types of related services. Many of the science based firms however fall into the category 10-49 employees or even fewer. This is particularly true for university start-ups. Many SMEs receive support from regional actors such as ALMI and SMEs in some regions also receive support via activities funded by EU structural funds. VINNOVA is relevant in this sphere as well but their initiatives that are directed to SMEs would be connected to VINNOVA's strategic areas. For instance, SMEs are included in the FFI programmes, the internationalisation programme and last but not least the Institute Excellence Centre programme also mentioned earlier. The third actor of interest in creating conditions for supporting innovation in SMEs is the Knowledge Foundation and their initiatives aimed at partnering university colleges and SMEs such as Researcher Profiles.[82] The Swedish Energy Agency also provides support and loans to SMEs in the new and emerging technology area. Swedish Industry - an interest organisation for firms in Sweden presented a report (SN, 2014[83]) recently which shows that Swedish SMEs prefer to sell rather than share ownership with investors and risk losing control of their companies. Additionally, this report also showed that institutional ownership was more common than private ownership in Sweden.

There is no shortage of initiatives aimed at SMEs in Sweden; in fact if one were to hazard a guess, there may very well be a problem with respect to the proliferation of these initiatives. SMEs are notoriously under resourced and may be unable to get a good overview of all the initiatives aimed at them. An emerging issue for these activities is that they are very difficult to evaluate. Recently, the Swedish Agency for Growth Policy Analysis was charged with evaluating ALMI's support to companies and this evaluation raises some of the issues that may be relevant for all these services. The evaluation focused only on the impact of the business counselling aspects of ALMI's activities. Business counselling was operationalised as (i) ALMI having visited the firm at least once and/or (ii) the firm having made at least two counselling visits to ALMI. Impact was defined as 'borderline significant positive effects on production value and employment rate for some years

[81] Svenskt Näringsliv (2014) För aktivt ägande aven i framtiden, slutrapport för projektet företagsamt ägande.

[82] http://www.kks.se/om/Nyhetsarkiv/Över%20300%20miljoner%20kronor%20till%20fyra%20nya%20starka%20forskningsprofiler.aspx accessed 2015-03-11

[83] Svenskt Näringsliv (2014) För aktivt ägande aven i framtiden, slutrapport för projektet företagsamt ägande. This report is a compilation of a number of projects which explored different aspects of the conditions for private ownership of firms in Sweden.

(Tillväxtanalys, 2014b).' The evaluation was inconclusive in part because ALMI apparently was unable to provide data on all the firms it counselled and secondly because of this, the evaluators were unable to establish any statistically significant impact of ALMI's activities on the firms it counselled. The Swedish National Audit Office performed a more extensive study of the entire public venture capital system and found that the government needed to review the number of such initiatives and clarify the objectives of the particular initiative. It was recommended that particular attention should be given to differentiating between regional development support and risk capital. Further the National Audit Office recommended that public risk capital conditions for co investment with private risk capital actors needed to be revised to provide incentives for the development of private early stage investment risk capital. Additional recommendations were made with respect to increasing the efficiency of public risk capital and reducing the administrative costs of these initiatives.[84]

4.6 Venture capital markets

Sweden has been working on improving availability of venture capital particularly in the early stages. The Swedish government introduced for the first time a deduction for investment in companies that are not stock market indexed (Jan 1, 2013). This is however a very limited arrangement since only companies with 50 or fewer employees are eligible and the deduction must be repaid on sale of the shares[85]. As mentioned earlier, the venture capital market in Sweden has a great many initiatives but this proliferation may itself be problematic because it may be time consuming for companies to get an overview and evaluate what options are best to pursue and at what point in time. The private market exists but is underdeveloped because of fiscal policies. Additionally, the Swedish pension funds continue to be a source of venture capital but not generally for early stage investment. The availability of venture capital through this route comes through the role of AP6 which is a fund based on a portion of pension capital and invests in the risk capital market. January 2014 saw a drastic reduction in the level of tax deduction for private savings towards pension. The amount deductible has now been reduced from €1000 to €193 annually. It is possible that the potential reduction in personal savings that this could encourage will be compensated for by the introduction of a new financial instrument. This is the investment savings account (investeringssparkonto).[86] This instrument allows individuals to maintain a personal account for shares, bonds, etc. which is taxed at a much lower rate than capital tax. The rate is based on the going interest rate and there is no tax per transaction. This is still very new and not many people are aware of the way it works. It is expected that once banks begin to market this instrument more aggressively, it could be a fillip for the private venture capital market. The majority of the Swedish population have

[84] Riksrevisionen 2014 Statens insatser för riskkapitalförsörjning-I senaste läget, RR2014:1 http://www.riksrevisionen.se/PageFiles/18786/RiR_14_1_Riskkapitalf%c3%b6rs%c3%b6rjning_Anpassad.pdf English summary available here: http://www.riksrevisionen.se/en/Start/publications/Reports/EFF/2014/Government-measures-in-venture-capital-provision-/

[85] See http://www.skatteverket.se/privat/skatter/vardepapper/investeraravdrag.4.10cbb69314111c2d94ba38b.html accessed 2015-03-01

[86] http://www.skatteverket.se/privat/skatter/vardepapper/investeringssparkonto.4.5fc8c9451325 accessed 2015-03-01

their personal savings tied up in pension funds and real estate (SN, 2014). The new government has started an Innovation council and one of their first tasks will be to consider how to best promote collaboration between the private and public venture capital initiatives.

4.7 Innovative public procurement

The results from the monitoring of public procurement show that larger companies are more likely to engage in some type of innovation in the context of public procurement contracts (Tillväxtanalys, 2014). Sweden's competitive advantage in innovative electronic administration reduced somewhat in 2014. An important contributing factor to this is that while the infrastructure for e-services is quite advanced, the supply of services is often not well matched to the demand. This report also shows that Sweden has been experiencing some difficulties in implementing the new innovation partnership rules for public procurement and that the current national interpretation may be working against companies in the service sector. Here the basic problem is risk-averse behaviour on the part of public officials. The most common problem is that public officials will apply the rules for bids very strictly in order to avoid unnecessary delays arising from among other things, suppliers contesting the decision. A number of revisions to the rules for tenders have been introduced in order to improve the situation. The most significant of which is that the limit for contracts that are excluded from the tender process has been increased to €54,000 and in defence this ceiling has been raised to €100,000. Procurement is clearly a priority issue and declining capacity is a concern. There is a website dedicated to this activity[87] and judging by the number of open vacancies, the lack of personnel in this area is clearly a problem for the public sector. VINNOVA and the competition agency have joined forces to promote innovative public procurement.[88] VINNOVA provides financing to public agencies to support new initiatives in public procurement such as the program 'innovativ upphandling' and the competition agency provides support and guidelines.

[87] http://upphandling24.idg.se/

[88] http://www.konkurrensverket.se/upphandling/innovation-och-upphandling/erbjudande-stod-att-framja-innovativa-losningar-i-en-upphandling/

5. Performance of the National Research and Innovation System

Sweden ranks sixth in Europe on the basis of the 2010 Community Innovation Survey. The latest survey of innovation activities in Swedish enterprises during the period 2010-2012 showed that about 53% of the enterprises were active in innovation. The share of innovation-active enterprises was 60% in the survey with the reference period 2008-2010 and 54% in the survey with the reference period 2006-2008 (Statistics Sweden 2014: Innovation activity in Swedish Firms). Total innovation expenditures for 2012 amounted to approx. €19m, manufacturing firms accounted for 76% of this expenditure and firms with 250 or more employees accounted for 66% of innovation expenditures. 12% of the firms with innovation (product and/or process) activities claimed that they had received financial support for their innovation activity. 22% of large firms i.e. firms with ≥250 employees received financial support, while 10% of SMEs and 12% of firms with 10-49 employees received similar support. A similar distribution pattern is obtained with respect to public procurement contracts with 41% going to large firms, 28% to SMEs and 23% to firms with 10-49 employees (Statistics Sweden 2014: Innovation activity in Swedish Firms). 56% of Swedish firms reported some collaboration with HEIs and 27% reported collaboration with public agencies or research institutes. This confirms that HEIs continue to dominate the public research performing sector. The pattern of firm collaboration with the public R&D sector mirrors the pattern observed for other types of innovation related activities mentioned earlier. For example, 80% of firms that reported collaboration with public R&D actors were firms with ≥250 employees, 60% were SMEs and 51% were firms with 10-49 employees.

5.1 Performance of the National Research and Innovation system

Sweden performs above the EU 28 average on most of the indicators outlined in table 3 below. In the last two decades there has been an intensification of effort to promote innovation and entrepreneurship in the research system. Unlike many EU28 countries, the rise in accountability pressure on Swedish universities was not focused on publications but on promoting collaboration with non-academic actors. Part of the reason for this may have been that the research system was quite good at producing high quality publications. Ironically, several studies have shown that the performance at this level has declined during the period of intense pressures.[89] This decline is not in absolute numbers of publications but in the percentage of highly cited publications produced. It is still unclear what is the reason for this but one significant variable that has not been investigated is the relationship between high dependence on project funding and the ability to produce highly cited publications.

In 2012, Sweden produced 32.02 publications per 10,000 inhabitants on average, which is well above the EU-28 average (13.8). International orientation is high with almost 56% of publications internationally co-published. In 2012, Sweden had about 1 711.9 international scientific co-publications per million population. In the period 2002-2012, almost 15% of the Swedish scientific publications were in the top 10% most cited publications worldwide

[89] http://www.vr.se/download/18.1ada9fde1266f78be66800015/Rapport+1.2010.pdf

in comparison with 11% of top scientific publications produced in the EU28 (Science Metrix, 2014)[90]. The share of public-private co-publications in Sweden is 3.4% in the period 2008-2013 against 2.8% for the EU28[91].

As mentioned several times earlier, the level of BERD in Sweden is higher than the EU28 average but not at the level that it has been previously (see Chapter 2). The key issue is concentration to a few large firms and the increasingly globalised market for R&D. In the light of this, much attention has been given to ensuring that Swedish R&D labour is at a level that is world class excellent. As a complement to this, successive Swedish governments since the 1990s have promoted policies that would foster the growth of high tech companies and this is reflected in the increasing public expenditure on R&D in relation to the EU28 average. This has in recent years been accompanied by a concern for ensuring that these fledgling firms have access to venture capital particularly in the early stages. Sweden still however lacks significantly behind the EU28 average on this issue.

Table 3. Assessment of the Performance of the National Research and Innovation System

1. ENABLERS	Year	SE	EU
Human resources			
New doctorate graduates (ISCED 6) per 1000 population aged 25-34	2011	2.90	1.70
Percentage population aged 30-34 having completed tertiary education	2012	47.90	35.80
Open, excellent and attractive research systems			
International scientific co-publications per million population	2012	1,711.93	343.15
Scientific publications among the top 10% most cited publications worldwide as % of total scientific publications of the country	2009	12.71	10.95
Finance and support			
R&D expenditure in the public sector as % of GDP	2012	1.08	0.75
Venture capital (early stage, expansion and replacement) as % of GDP	2012	0.08	0.08
2. FIRM ACTIVITIES			
R&D expenditure in the business sector as % of GDP	2012	2.31	1.31
Linkages and entrepreneurship			
Public-private co-publications per million population	2011	146.99	52.84
Intellectual assets			
PCT patent applications per billion GDP (in PPS€)	2010	9.98	3.92
PCT patent applications in societal challenges per billion GDP (in PPS€) (climate change mitigation; health)	2010	2.24	0.85
3. OUTPUTS			
Economic effects			
Contribution of medium and high-tech product exports to trade balance	2012	1.80	1.27
Knowledge-intensive services exports as % total service exports	2011	39.84	45.26
License and patent revenues from abroad as % of GDP	2012	1.28	0.59

Source: European Commission, IUS Database (2014).

[90] These publication data are based on Elsevier's Scopus database. ScienceMetrix, Analysis and Regular Update of Bibliometric Indicators, study conducted for DG RTD. They represent an update of the data displayed in the table below. See also http://ec.europa.eu/research/innovation-union/index_en.cfm?pg=other-studies.

[91] SciVal 2014, Scopus based publication indicators derived from Elsevier's SciVal platform, www.scival.com last accessed December 2014.

5.2 Structural challenges of the national R&I system

The 2012 national Research and Innovation Bill more or less takes its point of departure in the previous analyses (as communicated in the 2008 and the 2004 Research Bills and summarized in the ERAWATCH country reports of 2009, 2010, 2011 and 2012). The following structural challenges are highlighted:

- The general level of quality of Swedish (academic) research is already high but needs significant improvements to become globally competitive in coming decades.
- Interaction between the academic sector (basic research) and industry (applied research and development) is generally too low and inefficient, which shows not least in the suboptimal performance in commercialization of research results from academia.
- Swedish public research is impressive in its breadth but needs to improve its specialization and performance in certain cutting-edge fields, and prioritize more clearly between focus areas and less important areas (Hallonsten, 2013).

Table 4. Policy measures addressing structural challenges in Sweden

Challenge	**Policy actions addressing the challenge**	**Intervention/Funding Instrument**	**Assessment in terms of appropriateness, efficiency and effectiveness**
Increasing the global competitiveness of Swedish research	Attempts to promote resource concentration	Identification of Strategic research areas	Overall sound initiative Appropriate scope + funding period
		Centres of Excellence	Could have employed more discipline specific instruments Sustainability questionable because of university finances
Increasing university-industry interaction.	Open innovation initiatives in priority areas (energy & transport)	Strategic Vehicle Research and Innovation (FFI)	Too early to assess effectiveness. Cross cutting investment that would tackle climate change, energy and transport issues
	Effort to increase mobility between university & industry	FLEXIT for HSS internships in firms, public sector actors, NGOs, etc.	Moderate response but has been successful although it is very limited
		Knowledge foundation Strategic Knowledge Enhancement	Will be started this year

Challenge	Policy actions addressing the challenge	Intervention/Funding Instrument	Assessment in terms of appropriateness, efficiency and effectiveness
Balancing quality and increasing participation in tertiary education	Reduction in number of places available	Increasing price per place while allowing fewer places	Not applied long enough to judge. New government has promised to increase the number of places
Increasing university autonomy	Proposed foundation reform.	Expressions of interest invited	Little enthusiasm from universities because historical experience is that this policy is not party neutral
Framework conditions for innovation	Increasing BERD	Introduction of R&D tax incentive 01/2014	Too early to assess
Addressing the balance between private and public venture capital	Incentives for investment in companies that are not yet on the stock market and have <50 employees	Investor deduction since 2013	Unclear and the limitation to companies with fewer than 50 employees sends a mixed signal about attitude to growth in company size
	Reduction in capital gains taxes	Investment savings account	Still too early to assess

While there has been much focus on research in the last two Research Bills and in the Innovation Strategy, a perusal of the education system would reveal that there are significant challenges across the entire system. These challenges were acknowledged in the last national election at least as they relate to the primary and secondary levels. Less known outside the sector are the problems that exist with respect to education at the tertiary level. In the last ten years, successive Swedish governments have given great attention to issues of quality in tertiary education but there is an unacknowledged tension between the commitment to providing free tertiary education and providing high quality education. The market for higher education is largely monopsonic, with the state being the most important customer and the one that sets demands for quality and standards. The recent introduction of a parallel market for non EU students is illustrative of the fact that there is much to be learnt about higher education markets. Universities are all, despite reputations and offerings, required to charge the same fee to non EU students. In connection with this, the state has reduced the block grant for education by approximately €58m in 2013 (Swedish Higher Education Authority, 2014) which is the year that the budgetary consequences of the reform came into full effect. This reduction is intended to anticipate the income that universities would receive from fee paying students. The latest available information shows however that this projection did not hold true as universities' income from fee paying students was about 56% of the €58m they lost in direct allocations from the state in 2013. Although all universities charge the same fee, their income from fees varies considerably with Lund University being the highest earner and

the Royal Institute of Technology and Chalmers are the other two high earners. Of these, only Lund University has been able to attract enough income from fees to compensate for the reduction in the block grant from the state.

Little attention has been given to the prerequisites for competing for students in a global higher education market. The most recent report from the Swedish Higher Education Authority shows that the resources devoted to tertiary education have not increased at the pace equivalent to that observed for research (Swedish Higher Education Authority, 2014). The experiment with introducing fees may therefore not have much needed learning effects since universities have not risen to the challenge of introducing the reforms necessary to compete in the global market for students. There has been little effort on the part of governments across the ideological divide to communicate to universities what the selective introduction of a fee system is intended to signal.

A great deal of attention is given to internationalisation at the level of policy and there is even a research foundation dedicated to funding efforts at internationalisation in higher education.[92] Sweden is clearly a popular site for international students at the level of doctoral training, the 2014 annual report shows that 33% of those registered for doctoral programmes in the fall term were international students (Swedish Higher Education Authority, 2014).

Another set of structural challenges relate to the lack of a systematic policy for dealing with incentivising sustainable provision of private risk capital. This is coupled to two issues: (a) creating R&D tax incentives and (b) providing early stage risk capital. Both issues may be related to a tendency that holds across party lines in Sweden, i.e. to bias fiscal experimentation away from increasing liquidity in the economy and towards policies that rely on public institutions imitating market functions. The proliferation of innovation offices and public support for entrepreneurship is a clear example of this preference.

A related structural challenge is the paucity of measures to promote mobility from the corporate to university or other parts of the public sector. Apart from the long documented instances of industrial doctoral students and adjunct lecturers and professors, there are few instances of mobility from the corporate to the university or public sector.

Last but not least is the recurring issue of creating framework conditions for SMEs and that of promoting the development of innovative capacity in the public sector. Sweden has recognised the problem with SMEs and there have been several attempts to amend the various issues surrounding SME development and growth. The focus on public procurement or innovative public procurement appears as a particular priority in the 2012 National Innovation Strategy and progress towards this goal is monitored by the Swedish Agency for Growth Policy Analysis.

5.3 Meeting structural challenges

Among the structural challenges outlined above, it is probably those associated with research and education that are recognised as most critical on the policy agenda. The proposed introduction of a national evaluation scheme for research is the latest effort to try to increase the share of institutional funding without retreating from a commitment to

[92] STINT, The Foundation for the Internationalisation of Higher Education and Research has existed since 1994. See table at end of Chapter 1 for budgetary information.

a performance based system of resource allocation. There are a number of issues that remain to be addressed beyond this with respect to universities' capacity to do meaningful strategic planning but as yet, these are not on the agenda. It is not yet clear when the National Evaluation System will be implemented.

The Swedish Higher Education Authority's 2014 annual report raised some of the issues related to tertiary education but there is still a great deal that needs to be addressed. There is much focus on internationalisation but the impact of the fee system for non EU students on internationalisation has generated little policy attention. The political focus, in so far as it is on education, is on the primary and secondary school levels where the Pisa performance has made it impossible to ignore. There are as yet no concrete measures in this direction but it is clearly a political priority. The combination of the impasse with respect to the budget for 2015 and the strong ideological vested interests associated with alternative pedagogical traditions are the most immediate obstacles to a clear political strategy on this front apart from the commitment to devote more resources to the area. Beyond this, there is the issue of finding a strategy that would at once address the needs of the immigrant population in the school system without making them scapegoats for the current performance levels.

A new tax incentive for R&D expenditure was introduced in January 2014. This allows companies to deduct for investments in R&D to the tune of €276,000 per year. This deduction is only applied to personnel costs as it is not on total R&D expenditure but on the social insurance per employee (arbetsgivaravgift). The other two related structural challenges in this family are the issue of promoting the development of a private risk capital market and taxation for SMEs. The current government is keen on public venture capital solutions and has signalled this preference through its proposal to increase ALMIs budget by €14m from this year. Given ALMIs current approach, this choice would suggest a regional focus although not exclusively so. Additionally, to the extent that early phase risk capital has been part of the political debate since the election of a new government, preference has also been expressed for public-private partnerships on this front[93]. One of the concrete measures that has been proposed in this regard has been to change the focus of FourierTransform Ltd. FourierTransform Ltd. is a publicly owned venture capital company that has at present a brief to advance venture capital to new manufacturing firms. The proposal is to increase the company's brief to include early phase financing for start-ups in the life sciences and environment. [94]

The current proposal to deal with the persistent problem of how to support growth in SMEs given the high costs associated with personnel will be tackled once again. Within the current budget suggestions, the government has proposed to increase the level of support to companies in this category. This support will be limited to funding for covering part of the costs associated with coverage of salary for staff that is ill. The current social welfare net in Sweden requires that employers pay for the first two weeks of salary of employees on sick leave. The current proposal is to exempt small firms from this cost. About €32 m will be devoted to this effort and the instrument for this purpose will be designed so that the costs with low salary costs will get earlier compensation. No further details of the scheme or which classes of SMEs will be eligible are available at the present time.

[93] Riskkapital http://riskkapitaltidningen.se/marknadskompletterade-investeringsfond-i-tidiga-skeden/
[94] http://www.regeringen.se/sb/d/18393/fromdepartment/5709/pressitem/249660#anc249660

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Annex 2 - Abbreviations

BERD	Business Expenditures for Research and Development
ERA	European Research Area
DG	Directorate General (of the European Commission)
EC	European Commission
EU-28	European Union including 28 Member States
FAS	Swedish Council for Working Life and Social Research now renamed Forte
FP / FP7	European Framework Programme for Research and Technology Development / 7th Framework Programme
FFI	Fordonsstrategisk Forskning och Innovation - Strategic Vehicle Research and Innovation
FOKUS	Forskningskvalitetsutvärdering i Sverige – Research Quality Evaluation in Sweden
Formas	Swedish Research Council for Environment, Agricultural Sciences and Spatial Planning
GBAORD	Government Budget Appropriations or Outlays on R&D
GDP	Gross Domestic Product
GERD	Gross Domestic Expenditure on R&D
HEI	Higher education institutions
HRS4R	Human resources strategy for researchers
IP / IPR	Intellectual Property / Intellectual Property Rights
ISCED	International Standard Classification of Education
IU	Innovation Union
IUS	Innovation Union Scoreboard
KAW	Knut and Alice Wallenberg Foundation
NRP	National Reform Programme
OECD	Organisation for Economic Co-operation and Development
PRO	Public Research Organisations
R&D	Research and Development
RI	Research Infrastructures
RIS3	Regional and/or National Research and Innovation Strategies on Smart Specialisation
R&I	Research and Innovation
RJ	Swedish Foundation for the Humanities and Social Sciences
SCB	Statistics Sweden
Sida	Swedish Development Agency
SME	Small and Medium Sized Enterprise
VC	Venture Capital

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